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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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NOTES AND COMMENTS.

Institute of Metals—Birmingham Meeting.

The following Papers are expected to be submitted at the annual autumn meeting of the Institute of Metals, to be held in Birmingham on September 21-23:—(1) Professor A. A. Read, D. Met. (Cardiff), and R. H. Greaves, M.Sc. (Woolwich), on "The Properties of Some Nickel-Aluminium-Copper Alloys." (2) R. T. Rolfe, F.I.C. (Bedford), on "The Effect of Increasing proportions of Lead upon the Properties of Admiralty Gunmetal." (3) R. Genders, M.B.E., B. Met. (Woolwich), Note on "The Casting of Brass Ingots.' (4) T. G. Bamford, M.Sc. (Birmingham), on "The Density of the Zinc-Copper Alloys." (5) F. Johnson, D.Sc. (Birmingham), on "Experiments in the Working and Annealing of Copper." (6) W. E. Alkins, M.Sc. (Manchester), and W. Cartwright (Buxton), on "The Effects of Progressive Cold Drawing upon Some of the Physical Properties of Low-Tin Bronze." (7) R. Genders, M.B.E., B.Met. (Woolwich), on "The Extrusion Defect." (8) F. S. Tritton (Teddington), on "The Use of the Scleroscope on Light Specimens of Metals." (9) D. H. Ingall, B.Sc. (Birmingham), on "The Annealing of Rolled Zinc." (10) D. Hanson, D.Sc. (Teddington) and Miss M. L. V. Gayler, M.Sc. (Teddington), on "The Constitution and Age-Hardening of the Alloys of Aluminium with Magnesium and Silicon." (11) F. Adcock, M.B.E., B.Sc. (Sheffield), on "Electrolytic Etching of Metals." (12) S. Beckinsale, B.Sc. (London), "Note on "Electron" (the high-magnesium alloy).

Institution of British Foundrymen—Annual Meeting.

At a meeting of the Council, held in Manchester last Saturday, it was decided that the postponed Annual Conference should be held at Blackpool on September 14, 15 and 16. An interesting feature of the meeting will be the presentation of papers by American foundrymen. We hope to publish the complete programme at an early date.

Chilled Cast-Iron Wheels.

The "Iron Age," commenting on this subject, states that the vital rôle played by the chilled cast-iron wheel in the United States commerce and the need for chemical specifications to insure better wheels were emphasised anew at the annual meeting of testing engineers at Asbury Park. In six years losses on railways from accidents have increased over 200 per cent., or from roughly £6,600,000 in 1913 to £21,200,000 in 1919, due in large measure to poor cast-iron wheels. A large number of these wheels have proved to be of faulty composition and the situation is so serious that concerted action for the adoption of chemical and other specifications is necessary.

There is some surprise that the adoption of chemical specifications for cast-iron wheels by the American Society for Testing Materials is not already an accomplished fact, but it appears to be one of those matters on which producers in particular and consumers in general have been unable to agree. The regulation of the sulphur and phosphorus contents is a vital point in such a specification; but the problem of composition, which is easy for some Eastern foundries and less easy for some Southern and far Western makers, has been a stumbling block. Whether a maximum of 0.30 to 0.32 per cent. phosphorus insures a safer wheel or whether as high as 0.40 per cent. phosphorus can be tolerated in the interest of Southern foundries is a matter of importance. It was the opinion of experts at last week's meeting that 0.32 per cent. phosphorus as a maximum is the most desirable.

The sulphur question is also difficult. That a maximum of 0.18 per cent. sulphur is best and that a manganese content three times the sulphur is necessary were generally conceded. Too high a combined carbon is known to be very detrimental; yet there were cited cases of many wheels in service or failed whose combined carbon content far exceeded safe limitations. That cases of failed wheels are seriously numerous, in which the content of phosphorus and sulphur was beyond reasonable limits of safety, was brought out by H. J. Force at the meeting.

The suggestion of a stipulated percentage of nickel and chromium in cast-iron wheels, as offered by Mr. Force, is of more than passing interest. There are certain to be important developments in the near future in alloyed cast iron, and it is not improbable that nickel-chromium chilled cast-iron wheels will become an important factor in railway engineering.

There is also the suggestion that the phosphorus and sulphur question, as well as some cupola troubles, may be solved by the use of the basic electric furnace in conjunction with the cupola. Moldenke's opinion that this would directly and immediately solve most of the problems involved was strongly emphasised. As in steel rails so also in chilled wheels the time may come when the expense of making a better product will not militate against the general adoption of a new process.

Works of Messrs. Worthington-Simpson, Newark-on-Trent.

The Newark Works of Messrs. Worthington-Simpson, Limited, are the modern outcome of a business which was established so far back as the year 1790 by Mr. James Simpson, in Eccleston Street, London, being by his sons transferred from thence to Belgrave Road, and subsequently to larger premises in Grosvenor Road, London. The business was converted into a limited liability company in 1886, when the present works had their inception, the old premises being retained as repair shops.

The Works are situated about two miles from Newark, with sidings to the Newark to Nottingham branch of the Great Northern Railway. The shops are surrounded by extensive yards, which are traversed by a network of standard-gauge track; a 20-ton Avery weighbridge is installed, and a Smith (Rodley) 5-ton locomotive crane serves these sidings, as also the shops.

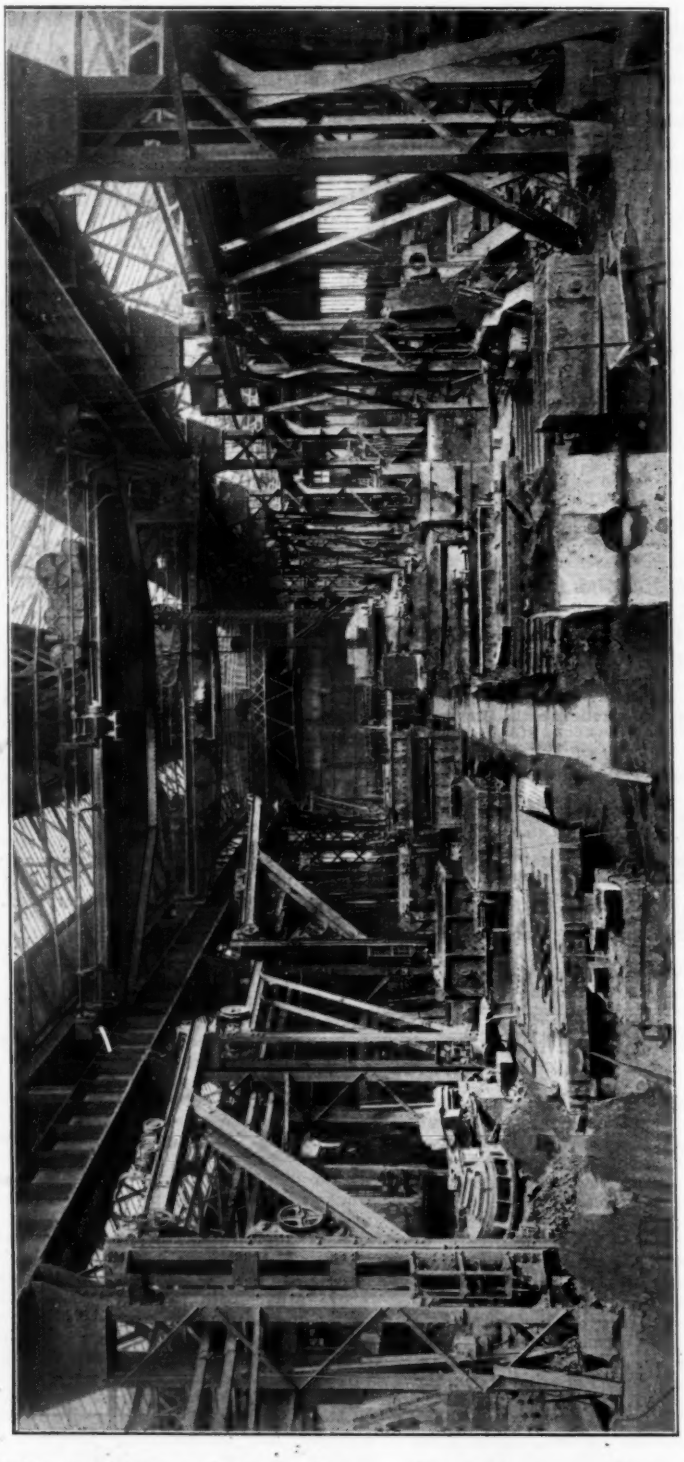

FIG. 1.—FOUNDRY; MESSRS. WORTHINGTON-SIMPSON'S WORKS.

The Works are entirely self-contained, comprising pattern shop, ironfoundry, brassfoundry, smiths' and plating shop, heavy and light machine shops, fitting and erecting shops, brass-finishing shop, test house, etc.

The pattern shop occupies a building 110 ft. × 80 ft., covered by two bays, and its equipment

comprises two band saws, two circular saws, planing and surfacing machine, morticing machine, sandpapering machine, drilling machines, three lathes, saw grinder, etc., the whole being driven from line shafting by a 30-h.p. motor. The foreman's office and the progress office are located between the bays.

The pattern stores are housed in a separate building, covered by ten bays; the whole of the patterns are carried on racks, indexed and numbered. There are separate stores for expensive standard patterns, and also a special store for centrifugal and turbine pump patterns. The pattern shop, pattern stores, and indeed the whole of the shops, are laid with trolley tracks.

The ironfoundry, with a floor space of 340 ft. × 120 ft., is covered by three bays. The centre bay runways carry a 40-ton and a 30-ton Babcock & Wilcox electric cranes, whilst each of the supporting columns carries a 3-ton electric jib crane. In this bay all the heavy castings are made. The side bays are devoted to medium and light castings, and are served by a 10-ton Babcock & Wilcox and a 10-ton Vaughan crane respectively.

The bulk of the work has of course to be hand-moulded. There are, however, a number of machines in service, including a jar-ramming machine (John Macdonald & Son, Limited), to take 30-in. boxes, three McNab power ramming machines to take boxes up to 15 in. × 18 in., and a Mumford plain jolt machine with a 5-ft. 6-in. table, which will jolt boxes and sand up to 35 cwts. There are three coke-fired drying stoves. The melting plant consists of three cupolas, with respective capacities of 14, 6, and 3 tons respectively. Blast is supplied by two Keith-Blackman motor-driven fans, and the cupolas are fed from a common platform, which is served by two electric hoists, each driven by a 10-h.p. motor. The casting ladles are carried on trolleys, which travel the foundry floor on a line of track.

The fettling shop, as at present constituted, occupies a building 190 ft. × 75 ft., the heavy fettling being done in the yard. This portion of the works, however, is in a state of transition, as it is in this direction that extensions to the foundry will shortly be made.

The brassfoundry occupies a building 105 ft. × 65 ft., the floor being served by a Vaughan 5-ton electric crane. The machines include two Tabor moulding machines, each of which will take boxes up to 35 cwts. There are two coke-fired core-drying stoves. Metal is brought down in a battery of eight Morgan tilting furnaces, each of 600 lbs. capacity.

From the foundry the castings are conveyed by bogie direct to the brass-finishing shop, which is contained in a building 115 ft. × 28 ft., and is equipped with some twenty-seven brass-finishing and capstan lathes.

The main machine shop is covered by three bays, each 365 ft. × 125 ft. The centre bay, where the heavy machines are installed, is served by two Vaughan cranes of 25 tons and 15 tons capacity respectively; the side bays, devoted to medium and light machines, are served by a 25-ton and a 10-ton Vaughan crane respectively.

For the most part the machines are arranged in groups. Thus there is a range of ten turning and boring mills, to take work from 3 ft. up to 24 ft. in diameter, a gang of planers with beds 3 ft. × 3 ft. × 6 ft. up to 21 ft. × 10 ft. × 10 ft.; and a battery of thirteen radial drills, all these last being separately motor-driven; a group of lathes, ranging from 6-in. up to 40-in. centres and beds up to 35 ft. in length; Norton grinders, and a very fine boring machine by Richards, Manchester, which is fitted up with two cross-boring attachments, and will face up to 9 ft. in diameter and bore 7 ft. long. All the heavier machines are separately motor-driven; three standard-size motors are employed—5, 7½, and 10 h.p. respectively.

FIG. 2.—PATTERN SHOP; MESSRS. WORTHINGTON-SIMPSON'S WORKS.

The erecting shop lies at right-angles to the machine shop. The main bay is 70 ft. × 200 ft. × 45 ft. high to the crane runway, which carries a 10-ton Babcock & Wilcox crane; above the crane runway there is a clear height of 12 ft. to the eaves. The side bay, of similar length, is 30 ft. wide × 25 ft. to crane runway, which carries a Vaughan 10-ton crane, there being 7 ft. clear head above the crane.

Amongst the work passing through the erecting shop at the time of our representative's visit special mention may be made of the Snow gas-driven blowing engine, which will be the second of this type of engine to be put down in Great Britain. The first engine, built by the Snow Steam Pump Works, Buffalo, was installed for the Parkgate Company by Messrs. Worthington-Simpson, Limited. So wholly satisfactory was its performance that the Parkgate Company immediately placed an order for a duplicate set, and this it is interesting to note has been built in its entirety at the Newark works.

The engine is of the twin-tandem horizontal double-acting 4-cycle type, with power cylinders 24 in. diameter, blowing cylinder 59 in. diameter, and a stroke of 48 in. When running at its normal speed of 88 r.p.m. the set is equal to a

duty of 25,000 cub. ft. of air per minute, with a discharge pressure of 8 lbs. above atmosphere. It occupies a floor space of 23 ft. 7 in. × 74 ft., and carries a flywheel 18 ft. in diameter, which weighs 40,000 lbs. The fuel consumption is approximately 10,500 B.T.U. per i.h.p. The engine can be started from cold and run light up to its full speed in three minutes, whilst in a further two minutes it can be put on full duty.

A separate shop, covered by two bays which are served by a 5-ton and a 30-cwt. electric crane, is devoted to pump work, which is, of course, a speciality of the Newark Works. In this connection it may be mentioned that the pumping plant for the Buenos Aires Waterworks was designed and built by Messrs. Worthington-Simpson, Limited, whilst at present going through the works is the whole of the pumping machinery for the New Delhi Waterworks; but centrifugal pumps for the lightest duties, boiler-fed pumps, and special pumps for oil-firing purposes, are also to be seen in large numbers going through the shop. The main tools in the machine shop comprise six turning mills to take work up to 36 in., ten lathes up to 12-in. centres, Churchill grinders for shaft-finishing, multi-spindle drills, facing and boring mills and planing machines. One end of the shop is laid off for assembling, and immediately adjoining is the pump test house, where test plates provide accommodation for twelve motor-driven and six steam-driven centrifugal pumps. Transformers are installed so that any desired voltage is available. The pump discharge is measured over rectangular weirs, there being three of such—*i.e.*, 2 ft. 6 in., 3 ft 6 in., and 5 ft., and the capacity is equal to testing pumps up to 30-in. discharge. A Babcock & Wilcox boiler is installed for supply of steam for the steam pumps; its working pressure is 250 lbs., and superheaters are installed to give 300 deg. superheat.

The power-house plant includes a Westinghouse turbo-generator of 300 kw., 220 volts; and a Parsons-Crompton 500 kw., 6,000 r.p.m., geared 750 r.p.m. 220 volts. The sets exhaust to Worthington-Simpson condensers, which are fitted with rotary air pumps. There are also three Willans compound engines coupled direct to Westinghouse generators of 100 kw., 220 volts.

In a separate house is installed a Laidlaw compressor of 500 cub. ft. capacity, at 80 lbs. pressure, which is belt-driven by a 150-h.p. motor. There is also a small Vickers boosting set driven by a 7-h.p. motor for boosting up the pressure to 100 lbs. for riveting.

Steam is raised in a battery of three Lancashire boilers 30 ft. × 9 ft., and one Babcock boiler fitted with a chain-grate stoker. The working pressure is 150 lbs., and the steam is superheated 100 deg. It is interesting to note that, in view of the coal crisis, the Babcock boiler has recently been fitted for burning oil fuel and is working very satisfactorily on the steam-jet system.

TUNGSTEN OUTPUT.—According to statistics recently issued by the United States Geographical Survey, the output of tungsten concentrates for 1920 was the lowest on record since 1902. The total production of the only two companies engaged in the industry was 216 tons of ferberite ore, which carries 60 per cent. tungsten trioxide. During the year 1,997,719 pounds of tungsten and ferro-tungsten were imported The material is used for manufacturing high-speed tool steel.

Mr. John De Hart, of the Isabel Porter Company, Newark, New Jersey, has been elected President of the local Foundrymen's Association.

THE Imperial Trade Correspondent at Brisbane has forwarded copies of specifications, conditions and forms of tender in connection with calls for tenders by the Queensland Water Supply Department in connection with the supply and delivery for the Inkerman Irrigation Scheme of (*a*) 54,000 yards of hard drawn copper cables of various diameters for overhead transmission wires; (*b*) 2,950 ft. of lead-covered and steel band armoured copper cables of various gauges, with accessories. Sealed tenders, on the proper forms, will be received by the Under-Secretary, Treasury Department, Brisbane, Australia, up to Monday, July 18. Particulars at the Department of Overseas Trade (Room 59), 35, Old Queen Street, Westminster, S.W.1.

Effect of Overstrain on the Elastic Properties of Steel.

In "R.D. Report No. 45," issued by the Research Department at Woolwich, the results are given of a series of experiments on the elastic properties of steel, conducted by MR. R. H. GREAVES, M.B.E., comprising (1) 1-in. diam. bar with 0.34 per cent. carbon; (2) proof shot normalised, with 0.50 carbon, 0.16 silicon, 0.70 manganese, 0.048 sulphur, 0.056 phosphorus; (3) 2½-in. diam. bar, with 0.77 carbon, 0.12 silicon, 0.34 manganese, 0.03 sulphur, 0.027 phosphorus; (4) 12-in. howitzer jacket steel, with 0.34 carbon, 0.10 silicon, 0.64 manganese, 0.031 sulphur, 0.025 phosphorus, and 3.65 nickel; (5) cast 12-in. high-explosive shell, with 0.32 carbon, 0.24 silicon, 0.49 manganese, 0.031 sulphur, 0.024 phosphorus, 2.12 nickel, and 1.45 chromium; (6) 1-in. sq. bar, with 0.30 carbon, 0.16 silicon, 0.26 manganese, 0.017 sulphur, 0.028 phosphorus, 1.95 nickel, and 5.23 chromium. Nos. 1, 2, 3, 5 and 6 were tested longitudinally, and No. 4 transversely. The tensile tests were made on test pieces 0.564 in. diam. and 2 in. acting length. The extensions occurring with increments of 1 ton per sq. in. during loading were measured by means of the Ewing extensometer reading to 0.000008 in. The diameter of the test piece was measured between successive loadings, and the acting length was machined parallel if, as occasionally happened after considerable overstrain, any local reduction of area had occurred.

Samples of steels Nos. 3 and 5 were overstrained in compression and then machined to tensile test pieces and tested in tension, (*a*) immediately after overstrain, when a fall of the elastic limit almost to zero had occurred; (*b*) after heating to 100 deg. for such a time as would be expected to effect complete elastic recovery in tension after overstrain in tension. There was marked lowering of the elastic limit in tension after overstrain in compression. Low-temperature annealing will raise the elastic limit so lowered, but probably not to its original value. The constancy of the elastic range after recovery has not been investigated.

In No. 1 (0.34 per cent. carbon) steel, after moderate overstrain (1.5 per cent. extension) 10 minutes at 100 deg. C. was sufficient to produce recovery, but this was insufficient after considerable overstrain (additional 6.5 per cent. extension). A further 30 minutes at 100 deg., however, almost completed recovery, but Young's modulus, which completely recovered with elastic recovery after moderate overstrain, had not quite reached its original value. The modulus calculated from contraction on removal of the load approximated to Young's modulus after slight overstrain, but was much lower when the steel was in a greatly overstrained condition.

In No. 2 (0.50 per cent. carbon) steel, the elastic limit was lowered whether the load producing overstrain was removed immediately or allowed to act for 1¼ hours. Complete recovery occurred after 12 hours at 100 deg., and partial recovery after a lapse of 32 months at atmospheric temperature. After further overstrain recovery was almost complete after one hour at 195 deg. C., a treatment which was again effective after additional overstrain. Young's modulus reached its initial value after the first and second recoveries, but the final value was slightly lower, possibly because recovery had not been quite complete. The contraction per ton per sq. in. on removal of the load was much greater in the overstrained material than that corresponding to Young's modulus, and varied considerably according to the extent of the overstrain.

No. 4 (nickel gun) steel had been overstrained by a premature giving a permanent extension of about 2 per cent. Recovery was not complete after 33 months at atmospheric temperature, 24 hours at 100 deg. C., or one hour at 150 deg. C.; but appeared to be practically complete after one hour at 200 deg. C.

In No. 5 (oil-hardened and tempered nickle-chromium) steel, the test pieces were taken from a heat-treated steel casting. Recovery appeared to be complete after 31 months at atmospheric temperature. It was not complete after one hour at 100 deg. C., but was complete after two hours at 100 deg. or one hour at 195 deg. C. The original

modulus was low for this cast steel, and was raised slightly after recovery from overstrain. Successive loadings of the overstrained material caused a progressive approach to the proportional line up to the load applied, the successive permanent sets tending towards zero. The proportionality reached by loading and unloading in this way was quite fictitious as an indication of elasticity of the material, and corresponded to a much lower modulus than the true modulus of the elastic material. Considerable yielding occurred if the range of stress was exceeded.

In No. 6 (nickel-chromium) steel with high chromium, air-hardened and tempered, owing to the big elastic range of the steel in the unstrained condition and in much smaller departure from proportionality after overstrain, it was somewhat difficult to determine exactly at what load the extensions definitely showed departure from proportionality. The lowering of the elastic limit was, however, clearly indicated. No treatment at temperatures up to 200 deg. C. for one hour produced recovery. Considerable recovery occurred after one hour at 300 deg. C., and again after further overstrain after one hour at 350 deg. C. Even after treatment at that temperature the primitive elastic limit had not been restored, but the Young's modulus had reverted to its initial value. The usual effect of overstrain in increasing the contraction occurring on removal of load was shown very clearly.

The author also directs attention to the behaviour of cold-drawn gun wire, pointing out that it is more difficult to effect recovery than in normalised steel of similar composition less severely overstrained, the conditions necessary being annealing at 200-250 deg. C. for one hour.

The report includes graphs and tabular details as to the results and the author concludes that while the results reported do not fully cover the ground, they throw light on the phenomena of overstrain, and subsequent recovery of elasticity, by indicating some important effects of variation in composition of the steel and in degree of overstrain. After overstrain in tension recovery proceeds slowly at atmospheric temperature and more rapidly as the temperature is raised, though when the temperature is raised beyond a certain point (differing in different steels) the elastic limit begins to fall owing to the usual softening effect. Recovery is not complete in a hard alloy steel after one hour at a temperature as high as 350 deg. C., but in steels of more ordinary properties recovery occurs rapidly at temperatures not exceeding 200 deg. C. The greater the degree of overstrain the longer is the time required to bring about recovery at a given temperature. It is probable that a temperature which will effect recovery after slight overstrain would, if sufficient time were allowed, effect recovery after considerable overstrain, but the extension of time would apparently have to be very great. The rate of recovery depends also on the composition and possibly on the treatment undergone by the steel, the harder steel in general recovering more slowly at a given temperature. All the steels tested show some progress towards recovery at atmospheric temperatures, but in the case of high-tensile alloy steels this is very slow. For a complete knowledge of overstrain and subsequent recovery of elasticity in a steel of a given composition, the effects of the following factors must be determined (1) previous heat treatment, (2) direction of overstrain. (3) amount of overstrain and possibly the rate of overstraining and the time for which the overstraining load was maintained, (4) temperature and time of recovery treatments.

The Amorphous Theory.

In a final note on the Amorphous Theory the author states that on this theory of strain hardening due to plastic deformation, yielding caused by slip on the gliding planes of individual crystal grains is accompanied by the formation of thin layers of amorphous material. This is initially in a mobile condition, in which state a very small stress causes flow. The steel in this condition therefore takes on permanent set at very low loads and is non-elastic. Similarly on unloading, the release of stress is accompanied by a viscous flow of the mobile amorphous material, resulting in greater contraction than corresponds to the elastic contraction of the crystalline metal. The backward creeping frequently continues in some materials after all load is removed. In process of time, depending on the temperature and on the composition of the steel, this semi-plastic condition passes away, and the amorphous material "sets" or becomes rigid. The mechanism of the setting of the mobile phase has not been satisfactorily explained. The material is still regarded as non-crystalline, but now as in a hard, non-yielding or vitreous-amorphous condition, typified by such substances as glass, vitreous silica, etc. The presence of this vitreous amorphous material prevents further slip on the same gliding planes and stiffens the mass of the metal. To cause fresh yielding a higher stress has to be applied, causing slip along fresh gliding planes, with accompanying formation of more amorphous material in a mobile condition.

The amorphous theory provides the only known explanation of the lowering of the elastic limit by overstrain (the formation of a mobile amorphous material), the subsequent recovery of elasticity (the "setting" of the mobile material into a hard vitreous state), the hardening of metals by cold work (the conversion of crystalline material into hard vitreous material), and the softening of cold-worked metals by annealing (the re-crystallisation of the hard vitreous material).

The results described in the report neither add to nor detract from the difficulties involved in the amorphous theory. They show, however, that the mobile amorphous material formed in steel may differ greatly in its viscosity according to its composition, and probably as a corollary of this, in its rate of setting to the vitreous amorphous condition.

Steels which recover slowly from the effects of overstrain and require high temperatures to bring about recovery in short times may be expected to increase in tensile strength when tested at these temperatures, and to show a maximum tensile strength at a temperature at which recovery becomes very rapid, *i.e.*, at a much higher temperature than that at which mild steel reaches its maximum.

DELAWARE RIVER BRIDGE REPORT.—The Department of Overseas Trade has received from his Majesty's Consul-General at Philadelphia (Mr. G. Campbell) a copy of the engineers' report on the proposed bridge across the Delaware River in Philadelphia. The proposal awaits the sanction of the city authorities before tenders are invited for the construction of the bridge, which work may possibly provide an opening for the supply of materials from the United Kingdom. The report is available for inspection by United Kingdom firms on application at Room 50, of the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

TANGIER-FEZ RAILWAY.—His Majesty's Consul-General at Tangier (Sir Herbert L. White, K.C.M.G.) has forwarded copies of the specifications and conditions of tender in connection with the invitation to tender for the supply of 3,000 tons of rails (French standard—36 kgs. grammes per metre) and 8,000 pairs of steel fishplates for the Tangier-Fez Railway. The adjudication of the tenders is to take place on August 20 next. The documents which are in French may be inspected by United Kingdom firms interested on application to Room 50, of the Department of Overseas Trade, 35, Old Queen Street, Westminster, London, S.W.1.

CHILIAN STATE RAILWAY REQUIREMENTS.—Tenders are invited by the Chilian State Railways up till 10 a.m. on August 31 next for the supply of emery and grindstones; bolts, nuts, cotter pins, rivets, nails and screws; telegraph and telephone apparatus, chemicals, etc. The estimated value of the material required is £44,000. Copies of the specifications (in Spanish) may be seen by United Kingdom manufacturers and exporters on application at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1. It is understood that the representative of the Chilian State Railways in Paris (88, Boulevard St. Michel) has been instructed to obtain prices in the United Kingdom and remit same by cable on the day previous to the opening of tenders.

XUM

A New Canadian Foundry.

In a recent issue of the *Canadian Foundryman* some details are given of the new foundry of the Canadian branch of the Grinnell Manufacturing Co., manufacturers of automatic fire extinguishers and cast-iron pipe fittings.

The building illustrated in Fig. 1 is a three-story structure with the foundry on the second flood. The first floor is not in a basement, but is on a level with the surrounding grounds. On this floor the sand is stored and mixed by machinery. The tumbling mills and grinding machines are also installed on this floor.

On the second floor is the foundry proper. Even the cupola is on this floor. The third story contains the sand conveyors for delivering the sand after being mixed to the chutes which lead to the moulding machines. Everything about the place is so complete that the moulders do not require to have either shovel or riddle, and do not pour any of their work. When the moulding sand is brought to the foundry it is unloaded into a bin within the walls of the first story. The walls of a bin must be vastly more substantial than the ordinary walls of a foundry building, and in order to make double use of the extra strength of this point, the bin is built under the charging floor of the cupola. It is of reinforced concrete, and is much heavier than the remaining walls of the building. This bin does not cover the entire space beneath the charging floor, for the reason that the drop from the cupola goes right down to the bottom, and is held in a small bin which constitutes the foundation for the cupola. At one end of the first floor is a heavy work bay setting across the building. This is served by an electric travelling crane manufactured by the Northern Crane Works, Walkerville, Ont. This bay is used for the heavy fittings and is on the ground floor, so as to be able to have the foundations for the heavy Osborne jolt machines under ground. The metal is melted on the upper floor and delivered to the moulders on this floor with the same degree of ease as though everything were on the level, the crane being placed at a sufficiently high level to permit of this. With this exception, all the moulding, core making, melting, and pouring is done on the second floor.

A cycle of the operation of the foundry will be of interest. Presuming that the moulding sand has been used at least once and has been knocked out of the moulds, it falls through a grate in the floor at the back of each moulder (or, more exactly speaking, in front of each moulding machine). These grates are connected with chutes which lead to large sand bins on the two opposite sides of the ground floor. These bins are served by overhead trolley tracks carrying a grab-bucket. After each batch of sand falls into the bin it is wetted and new sand introduced from the new sand bin. The grab-bucket now lifts up portions of the new and old sand and lets it fall. After doing this a few times, it is put into a hopper which connects up to conveyors which carry it to the third floor. The conveyors, in passing through the hopper, mix it by scraping off a little of every kind of sand. When it gets to the third floor it is discharged into a standard sand sifter and mixer. This machine sifts out all scrap and allows the sifted sand to drop into the paddles, which work similar to a dough mixer. From here it drops into a Sellers centrifugal mixer, which aerates it and mixes it thoroughly.

From here it is conveyed to every part of this floor and delivered to chutes which are directly over each moulding machine. When a mould is to be made the machine operator simply opens the chute and lets the sand drop into the flask. The machines thus connected are for the lighter work, and are manufactured by William H. Nicholls Company, Inc., Brooklyn, N.Y., but for the larger sizes of fittings which are made on the ground floor, the jolters and pattern drawing devices were manufactured by the Osborne Manufacturing Company, Cleveland, Ohio.

The machines on the second floor are placed in rows—one row on each side of the room. As the moulds are made the moulder places them in rows behind his back, which is all he has to do with them. The cupola is put into blast first thing in the morning, and as the moulds are made they are poured by men who are engaged for this purpose only. The pouring floors are served by overhead trolley tracks carrying a number of pouring devices supplied by the E. J. Woodison Company. These devices are so arranged that practically no exertion is required on the part of the workman, who can pour all day without difficulty, which would be a difficult proposition by the hand method.

The moulds, after being poured, are knocked out over the floor grates, and the sand falls to the bins below, to go through the same process over and over again.

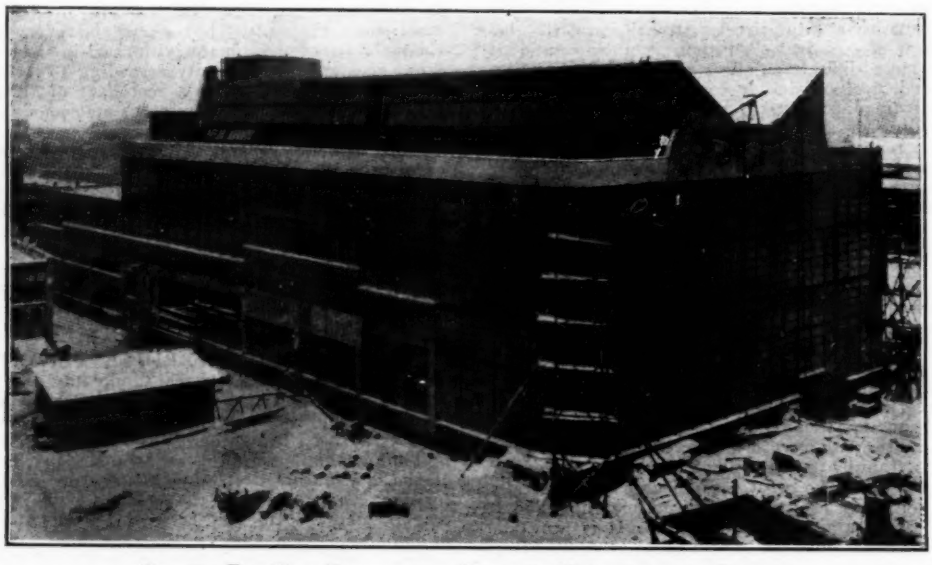

FIG. 1.—THE NEW FOUNDRY OF GRINNELL MANUFACTURING COMPANY.

Core-Making.

As might be expected, the core-making on this class of work is about as extensive as the moulding, and is carried out with a similar amount of automatism. Some of the cores are made on the core bench, but many are made on the Woodison pneumatic machine. The cupola is of the Newton type and the blower was manufactured by the P. H. and F. M. Roots Company, Connersville, Ind. The tumbling mills and the ladles were manufactured by Whiting Corporation.

The H. M. Lane Company, of Detroit and Windsor, designed and superintended the construction of the buildings as well as the equipment.

Purifying the Trimming Shop Atmosphere.*

It is nowadays considered essential to extract the dust from the trimming shops. Although the ordinary cleansing of castings produces much noxious dust, the sand blast is the most culpable plant in the department. As the sand should be re-employed it is desirable that the dust, which is introduced through the breaking up of the silica grains from the sand and carbon from the cast-

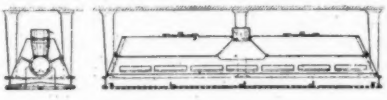

FIG. 1.—ARRANGEMENT OF DUST EXTRACTOR ON A FETTLING TABLE.

iron, should be removed, as it reduces the efficiency of the blast, and, if any humidity is present, clogs the pipes. Several systems have been thought out for this purpose.

With the rotating-table apparatus good results have been obtained by creating a suction of air towards the interior, and thereby stopping the dust from leaving the table. So far as totally enclosed apparati, which work under a relatively large vacuum, are concerned, it should not be lost

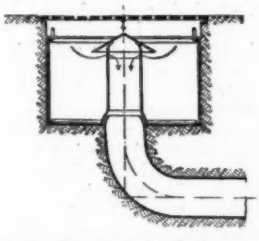

FIG. 2.—LAYOUT OF A SECTION OF THE FETTLING SHOP FLOOR.

FIG. 3.—FORMATION OF CONDUIT PIPES.

sight of that it is necessary to admit air in sufficient quantity to create a draught large enough to carry the dust with it.

For sand-blast chamber work it is necessary to prevent all leakage of dust, and also to protect the operator efficaciously against both dust and sand. For this, the use of adjustable rolling doors is to be recommended, and, additionally, the normal working position of the workman should be

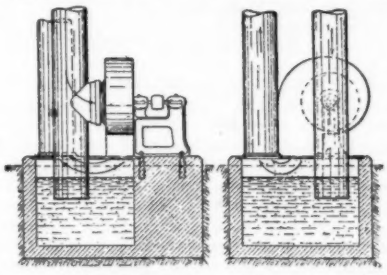

FIG. 4.—WET METHOD OF ELIMINATING DUST.

arranged so that it is in a strong draught of fresh air. The provision of hoods, similar to those usually associated with blacksmiths' hearths on de-coring benches is useless, as the dust, unlike fumes coming from the combustion of coke, is heavier than air; therefore, the aspiration should be from beneath, so as to bring fresh air to the operator.

Fig. 1 shows a type of fettling bench of rational construction, wherein the dust is aspirated by a tube running longitudinally the complete length of the table. The dust is collected in a suitable receptacle which is periodically emptied.

The lay-out of a section of the fettling floor is shown in Fig. 2. Beneath the grating a box is provided which can be removed, when full, by means of the crane.

For large plants, a number of sections can be served by a common transporter arrangement.

* Extracted from "La Fonderie Moderne."

It is difficult to give precise information as to the dimensions of the conduits, but it may serve a useful purpose to state that the junctions should be formed at very acute angles, as shown in Fig. 3. Suitable air speed is from 10 to 15 metres per second; a lower speed is useless, as it results in the formation of deposits which automatically establish the necessary speed. The following table gives the relative figures for the amount of air necessary to aspirate. They should be looked upon as an average for well-constructed installations.

Apparatus.	Dimensions.	Cub. metres of air to be aspirated per min.
Sand blast chambers	4 to 25 metres	70 to 200
Rotating tables	1.5 to 24.4 metres dia.	50 to 125
Rumbling barrels	0.3 to 1.0 metre	30 to 70
Small sand blast	—	15 to 25
Benches and floor work	per square metre	10 to 20
Mills	each mill	5 to 10

The inverse pressure created by the blower naturally depends on the length and form of the conduits, but in the ordinary way an inverse pressure of 50 to 100 mm. of water is sufficient.

The function of an apparatus designed to clear the atmosphere of dust is not strictly limited to

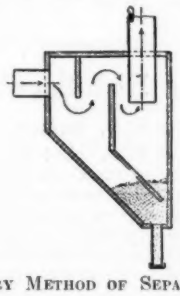

FIG. 5.—DRY METHOD OF SEPARATING DUST.

absorption, but it should precipitate it. Assuming that the dust is composed of numerous hard particles with sharp edges, naturally they are capable of exercising an abrasive action on the fan, therefore, it is advisable to eliminate them *en route*. For this purpose several processes have been designed:—(1) The air is made to pass

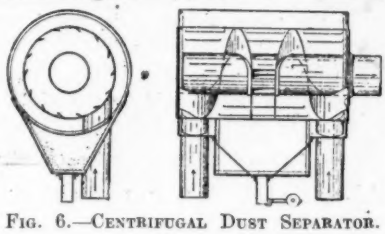

FIG. 6.—CENTRIFUGAL DUST SEPARATOR.

through a large chamber provided with baffles, so disposed that they slow down its passage to a minimum, so that the dust may be deposited. (2) The filtering of the air through a fabric gives a complete clarification, but the interstices of the material soon close up. (3) The impinging of the current of air on a wet wall undoubtedly gives good result.

Fig. 4 shows a type of apparatus for eliminating dust by a wet method. The air does not reach the pan by an elbow, but by a T-piece, of which one arm projects into a cistern. With this lay-out the larger particles brought in by the air are eliminated before reaching the fan, thus protecting it from excessive wear, but for installations of this type it is recommended to interpose a dry cleaner to deal with the heavier dust.

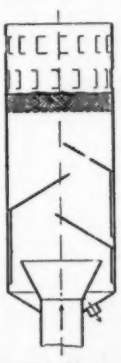

FIG. 7.—ARRANGEMENT FOR DILUTING DUST-LADEN AIR.

A separator of this kind is shown in Fig. 5. It is made of wood, and the separation of dust is carried out by direction and speed changes. These apparati are economical, but sustain a distinct power loss, and their efficiency is thus only rela-

tive. The centrifugal air purifier of the Badische Maschinen Fabrik, of Durlach, surmounts these inconveniences, as shown in Fig. 6. In this machine the dust is separated in a special annular space, where it is extracted by contact with a draught, which is kept at a constant speed, owing to the construction of the apparatus.

If the fettling shops are situated near to dwelling houses, when the question of the extraction of dust becomes more important, it is essential that the cistern, the baffle chambers, and other apparatus should be of ample dimensions. In particularly bad cases, it is advisable to instal a water pulverisor at the end of the exit pipe blowing in the opposite direction to the air, or sometimes a coke filter placed in the orifice of the pipe will meet the case. Another method is to instal the arrangement shown in Fig. 7, which consists in cylinder provided with vertical tangential cracks and internal vanes. By this means an intimate mixture is formed between the outside air still containing traces of dust. Thus, after dilution, the dust is less visible and less annoying. Quite often this apparatus can be replaced by a chimney built 6 ft. higher than the roof, and this, associated with a large chamber, can generally be relied upon to give ample purification.

Hardening High-Speed Steel.*

By A. J. WILSON.

High-speed steel is of vital importance to all lines of manufacture, for there is no manufacturing concern that is not more or less interested in the use and conservation of tools and tool steel. This applies more especially to the automobile or automobile parts manufacturers whose tools, particularly high-speed tools, are a very large item of expense.

The forge man must make certain that his steel is heated through uniformly. The outside may be up to forging heat and the inside many degrees cooler. The effect of this can be appreciated readily if a piece of steel in this condition were to be put under the hammer. The outside being softer than the centre would prevent the hammer blows from displacing the metal in the centre of the piece, therefore it would cause a number of small ruptures which undoubtedly would cause trouble in hardening.

No tools should be hardened direct from the forging operation, but should be annealed before hardening. To save time this may be done by heating them to about 895 deg. C. in the forge fire and then burying them in ground mica, which, for convenience, can be kept in a cast-iron box near the forge. Air slacked lime also will answer the same purpose

After being annealed the tools are ground before hardening, so as to have the least possible amount of stock to remove after the hardening operation. In hardening high-speed steel the advantages derived from proper preheating cannot be overestimated. Preheating to 785 to 840 deg. C. in a slow furnace and then bringing the heat up quickly to 1,230 to 1,260 deg. C. in another furnace generally gives satisfactory results. Although in the case of an intricate tool which is liable to crack, better results may be obtained by two preheatings, one about 785 deg. another about 955 deg. C., and from this placing the tool into the hardening furnace. Handling the tool in this manner, the shock of being transferred to hardening temperature is not so great and aids by not causing quick expansion of the thinner sections which naturally heat the more rapidly.

The supposition that any fire is good enough for preheating is erroneous, because the same care must be exercised in running a furnace for preheating as for final heating if best results are to be obtained and the tool is to come out free from scale. Tools must not be allowed to soak in the preheating furnace.

As a quenching medium, fish oil, a standard soluble quenching oil or coal oil, will give good results. Coal oil is a little more drastic, and it must be used with some caution on account of its inflammable nature. For turning tools, boring tools, and the like, where points only are hardened, and a little scale does not matter, an air blast will be found satisfactory provided that the air is free from moisture.

During the past few years much experimenting has been done in tempering of high-speed steel tools, and it is along this line that the most improvement has been made. Tempering has been a common practice for years, but not to the extent that it is now carried on. It has been found that steel of standard make when properly hardened, using as high a heat as can be used safely, then tempering at 565 or 590 deg. C., will give its best service. This applies more directly to tools doing extremely heavy work and those required to remove a large amount of metal. The tool is tougher and stronger, still retaining its original hardness, and is not given to crumbling on the cutting edge.

With tools required to give a smooth finish and take a light cut, tempering at so high a temperature is not recommended, but a temperature of approximately 220 deg. C. in oil has been found to give satisfactory results. A tool tempered at this temperature will retain a keener cutting edge on light work than one drawn at 535 deg. C. Tempering through the intermediate temperatures, that is between 220 and 535 deg. C., has not, to the writer's knowledge, ever been productive of any marked degree of success. In fact, if it were found necessary to temper a tool made of high-speed steel beyond 260 deg. C., it is preferable to jump to the upper range. A chart issued by a well-known maker of steel gives some very valuable information in regard to high temperature tempering. This chart gives 370 deg. C. as the point at which the greatest softness occurs.

Before being put to work tools must be properly ground, care being taken to avoid drawing temper. It is customary to use a dry wheel, which should be free cutting and true. If water is used sufficient must be used to keep the tool cool, as alternate heating and cooling is very conducive to cracks, which will cause trouble later on.

An occasional bar of steel will contain a pipe or seam. This can be determined easily by the appearance of the crack in the hardened tool, and if the bar of steel from which this tool was made is examined, the seam or pipe generally can be discovered without much difficulty. Such a bar is practically worthless, but such cases are rare, and most of the failures in tools can be laid at the door of the men who handle the steel after it is in the manufacturing plant. In other words, there is much more trouble due to faulty methods of handling than to defective steel.

* Extracted from the "Canadian Foundryman."

MAGNESITE IN MANCHURIA.—According to the "Trans-Pacific," Japanese mining engineers who have been carrying out mineral surveys along the South Manchurian Railway line state there are extensive and well-proved deposits of magnesite in Manchuria which are of great potential value. The magnesite is, in fact, too pure for making into the usual brick form without the admixture of 7 to 8 per cent. of iron. Whilst the Japanese own the larger part of the deposits, there are considerable areas still in Chinese hands. Associated with the magnesite are important talc deposits said to equal, if not excel, the best-grade French talc deposits. The known deposits of both of these substances are all within from 3 to 10 miles of the South Manchuria Railway.

SHELLAC.—Shellac, as every patternmaker knows, is one of the most essential items connected with a pattern-making establishment. Shellac is the product of a tiny insect which infests certain trees in the East Indies. The term lac is the same as the Hindu numeral lac—a hundred thousand—and indicates the countless myriads of insects which make their appearance each spring on the young, tender shoots of the infested trees. These feed upon the sap in the bark, and after passing it through their bodies exude it in the form of a crimson-coloured resin, which in course of time hardens into a tiny semi-transparent cocoon or shell. It is these cocoons which, after being melted in boiling water and poured out on a cold surface, constitute the shellac of commerce.

Some Factors in the Manufacture of Steel Castings.

By R. B. Farquhar, Jr.*

Only when the general principles underlying the handling of molten metal are understood clearly can satisfactory results be accomplished and the making of steel castings be reduced to something approaching an exact science. When these principles are not understood and applied, trouble is sure to be encountered, and producing steel castings becomes merely a haphazard rule of thumb practice. Under present conditions, foundries wherein guess-work methods prevail cannot survive. Undoubtedly there still are many foundrymen who do not recognise nor understood that many of these problems exist; hence, they cannot accomplish their solution. There are others who do understand them but do not apply a solution. There are still others who do generally recognise the existence of many of these problems, and who have encompassed their successful solution by the consistent application of scientific knowledge.

TABLE I.—*Showing Time required to Pour Large Steel Castings.*

Ladle	Tons
A	60
B	60
C	20
D	20
Total	160
Excess left in Ladle "D," 5 per cent.	8
	152
Added	2
Added	1.3
Total weight	156

No. 1 Runner.	No. 2 Runner.
1:28 to 1:34 p. m.	1:29 to 1:35 p. m.
1:34 to 1:37 p. m.	1:35 to 1:38 p. m.
	1:28 to 1:38 p. m.

Elapsed time—
10 min. to pour.

Feed at 2:08 p. m.
Feed at 3:30 p. m.

Molten, 2 hours, 2 minutes.

For a given volume of a certain temperature, the time required to make the transfer to accomplish the best results may vary greatly for different castings. By this it is meant that some castings weighing 2,000 lbs. should be poured much more rapidly than others of the same weight due to their shape, area or section. Furthermore, of two castings weighing 2,000 lbs. each, one might require much hotter metal than the other due to its shape, area or section. The right amount of elapsed time in the transfer from ladle to mould generally can be determined only by judgment or experience, and since it depends upon so many factors, often the only way to find out this time is by the costly method of a test or tryout, often at the expense of a lost casting. With large castings, this, of course, is expensive and must be avoided, and it is to be regretted that there are no laws, so far as the author is aware, which can be laid down and absolutely applied for the guidance of the foreman upon whom the responsibility rests for obtaining perfect castings. Actual elapsed time for pouring different castings from the largest to the smallest may vary from a few seconds to as much as 25 minutes in exceptionally large pieces. The latter extreme time was found necessary to pour some steel castings that weighed over 134 tons each. Four open-hearth ladles pouring simultaneously through three 5-in. diameter brick runners were required.

Probably the largest steel castings ever produced in the United States are the ones referred to. They weighed between 156 and 178 tons each and required about 40 tons of feed metal as much as one-and-a-half hours after pouring. The risers did not solidify until three-and-a-half hours after pouring. The copes were not stripped off these castings until 24 hours after pouring, and the annealing treatment took about 10 days.

Actual pouring time, taken from the author's notes, of the large armour plate mould shown in Fig. 1, is as shown in Table I.

The vents in the large cores of these castings retained their colour 10 days after they were poured, and these castings were not stripped until the fourteenth day after pouring, at which time they showed a dull red colour.

When pouring small snap flasks from shanks it usually is necessary to get the metal into the moulds in the shortest possible time and at the highest practicable temperature in order that it will run up and completely fill all portions of the piece. If a few seconds are lost in pouring such small castings, a misrun job may result. For light, thin sections the high temperature of the metal is no detriment, for since it solidifies so rapidly it will not burn into the sand and cause difficulty in cleaning as would be the case with large castings poured too hot. If the area is not too great, and the casting is properly gated, the high temperature should not cause cracks. On the other hand, many large castings should be poured as cool as possible, and hence as slowly as the

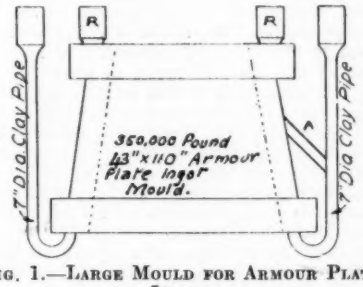

FIG. 1.—LARGE MOULD FOR ARMOUR PLATE INGOT.

temperature of the metal will permit and yet take completely and fully the impression of the moulds. Also, when poured cold and slowly, the metal will not burn into the sand so much, and there is less liability to check or crack. Just as the rapid pouring of ingots with metal that is too hot, frequently may be the cause of cracks, so may similar conditions be the cause of cracked castings. The author has seen cast-steel cylinders practically 10 in. outside diameter and 6 in. inside diameter by 58 in. long crack badly when poured fast with hot metal from the first part of the heat, when the same cylinder showed no sign of cracks when poured slowly at the end of the heat with cooler metal.

Since the rate of pouring a given casting should be arrived at partly by a knowledge of the temperature of the metal at the time of pouring, it is quite important that the approximate temperature should be determined and made known to the man in charge. By the use of a spoon test for temperature, immediately prior to tapping, an accurate estimate of the condition of the metal may be given to the man directing the pouring. In the foundry under the author's supervision this practice has become established to such an extent that the foundry foreman will give the head melter an order for the metal desired, whether for light-floor work or heavy main-floor castings, in terms of the number of seconds before solidification of the spoon test. If the heat is ordered for 80 seconds for snap flask work and the spoon test shows only 65 seconds, the man directing the pouring expects that he will have many misrun castings on the side floor. We have established the practice of pouring the snap flask work with shanks taken from the bottom-pour main ladle containing the whole heat, and if the initial temperature is not as high as desired, part of the side-floor may be poured from shanks and the remainder of the metal in the main ladle be

*Abstracted from a Paper presented at the Columbus meeting of the American Foundrymen's Association. The author, R. B. Farquhar, is connected with the Electric Steel Company of Indiana.

bottom poured into heavy main-floor work. It is the author's opinion that not nearly as much attention is paid to metal temperatures and pouring conditions by the average foundry foreman as the subject deserves, and as a result the percentage of defective castings, where much small work is involved, is much greater than might be the case were this important phase given more critical attention and intelligent study.

The most desirable elapsed time in which to pour a given mould may vary from a few seconds for snaps to 25 minutes in the case of the large casting briefly described. An infinite number and variety

FIG. 2.—THIN-WALLED CASTING REQUIRING SMALL RISERS.

of exceptions arise that require study, ripe experience, and often keen judgment. Even though the temperature of the metal is fairly well known, the man in charge must estimate how long he can keep it in the best condition to pour the moulds of a given heat, and it will be necessary to select the order in which the various castings should be poured according to their comparative weight, area and section, as well as their intricacy, liability to crack, check, etc. There is a nice balance to be determined, a great many factors are involved, and perfection of accomplishment is for ever just out of reach.

Principles of Gating.—The speed or rapidity of transferring the metal from the ladle to the moulds is controlled by the size of the runners and gates, and these must be determined for large castings from a knowledge of the laws governing the flow of liquids with given heads. The most desirable time in which to fill a given mould of large volume is much a matter of judgment and experience based on the factors already mentioned such as section, area and total volume. The gates of various castings may vary from a fraction of a square inch in cross section to as high as two 7-in. diameter clay pipe runners with an aggregate section of 77 square inches for large moulds. Gates may be single, double or multiple, and in large castings the gate may be what is known as *straight* height, as is indicated in Fig. 1 at *A*. This runner *A* half way up the large mould weighing 350,000 lbs. is highly desirable, since it will permit the hot metal to enter over the surface of the mould at that point at a time when the metal is still hot. The entrance of hot metal at *A* will thus make a smoother casting, and will run up better from *A* to the top of the casting, Fig. 1. It will also permit the metal at the bottom of the casting to begin to cool ahead of the metal at its top, from which point feed is drawn.

The gates on small castings may be Y-shaped, fan, horn, or straight, according to the design of the casting involved. They must be so arranged that they will not cut, wash, nor trap air. Gates should be placed so that they will introduce the metal into the mould at the spot least likely to cause cutting or disturbance of cores or sides of mould; objects not always easy of accomplishment. Consideration must be given to liability to hot or cold cracks upon solidification of the metal and the cooling and shrinking of the casting. In locating gates attention also must be paid to feasibility of their removal in the cleaning department with the greatest ease and least expense. Oftentimes gates may be designed and used as feeders for small and medium-sized castings, and occasionally feeders or risers may be used for pouring, thus eliminating the necessity for other runners and gates.

The successful feeding of castings only can be accomplished by a thorough knowledge of the physical laws which govern the solidification of different masses of molten metal. The study of relative masses adjacent to each other is of fundamental importance. Again, it is found, as in the case of pouring already explained, that the factors of volume, temperature, and time are the ones to be considered. These physical laws, in the opinion of the author, may be briefly summarised somewhat as follows:—

(1) Two equal masses of molten metal of the same temperatures and approximately the same area will solidify at the same time providing the containers or moulds are of relatively the same radiating and conducting power.

(2) Of two equal masses of molten metal, the one with the higher temperature will solidify after the one of lower temperature. The former will require more feeding after it has been poured, all other factors, such as nature of container, chills, etc., being equal, because the one of higher temperature has a far greater drop to the solidification point, and it will require more feed after being poured at such higher temperature due to its lower specific gravity or conversely due to its greater volume per lb.; hence its greater shrinkage in passing from its higher temperature to the temperature of solidification.

(3) Of two equal volumes of molten metal of equal initial temperatures, the one with the greater area per lb. of weight will solidify first because of the greater surface exposed to the conducting and radiating effect of its container.

(4) Of two castings of unequal volume, the one of smaller volume will solidify first provided the approximate areas and temperatures are the same, and the radiation through the containers are equal.

(5) Of two castings of the same initial temperature, of the same area but of unequal volume, the one of greater volume may solidify before the one of lesser volume through the introduction of artificial means such as "chills" to accelerate the cooling of the larger.

(6) The percentage of metal to feed two castings of the same volume may vary greatly if such castings are of radically different area and different section, the one with the greater area and thinner section requiring less feed after pouring but before solidification than the former.

The distinction should be borne in mind between the amount of metal required to feed a casting

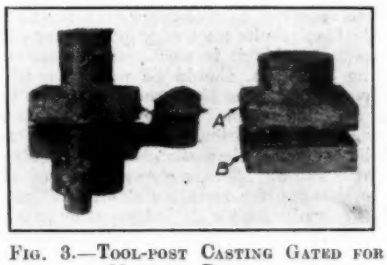

FIG. 3.—TOOL-POST CASTING GATED FOR MINIMUM DISCARD.

to get it perfectly solid throughout and the amount of riser or top discard remaining after solidification. The one may differ widely from the other, for by perfect feeding the amount of actual riser or top discard remaining after solidification may be greatly reduced if feeding conditions are well balanced.

Referring to the first law, the introduction of chills may be used to accelerate the cooling and hasten the solidification of the one mass or the other as may be desired. In regard to the second law, the writer frequently has seen many striking examples of this condition in pouring large castings. Extreme cases have been noted in pouring ingot moulds weighing from 67 to 156 tons each. He has seen such castings, when poured hot, require from 6.7 to 11 tons more of feed metal after the mould was originally filled, and before solidification, than the same castings required when poured with cool iron. In each case the weight of the remaining riser or top discard after the castings had become cool may be the same, but the amount of feed metal required to make the casting solid

differed tremendously. He has seen the same difference prevailing in pouring large steel castings.

Referring to third law mentioned, a casting such as is shown in Fig. 2 will solidify much quicker than the casting shown in Fig. 3, even though their weights be about the same because of the much greater radiating surface of the mould and the greater area over which the molten metal is quickly distributed and chilled. Theoretically, these two castings might be expected to require the same amount of feed, and perhaps they do, but the molten metal of casting shown in Fig. 2 is shrinking rapidly while pouring and when solidification has taken place, the actual amount of top riser or discard remaining is only about

FIG. 4.—SHOWING FEEDING OF GEAR BLANKS.

10 or 15 per cent., whereas in the case of Fig. 3, the molten metal in the mould is much longer in solidifying after having been poured, and hence a much larger riser or reservoir from which to draw feed as it cools will be required, and the amount of top discard remaining may be as much as 30 or 40 per cent. However, another condition prevailing in castings, such as Fig. 2, should not be overlooked. Where thin and thick sections are adjacent, it is possible that certain thin sections may shut off some adjacent thick sections from feed; hence, such adjacent thick sections will have shrinkage holes that cannot be fed. A casting in which such a condition prevails will lack the density possessed by a casting that has been perfectly fed in all portions, as shown in Fig. 3.

Referring to the fourth law: If the area of the heavier casting is far greater than that of the lighter, it is quite possible that the former may require a much smaller percentage of feed for its weight than the latter because of the accelerated cooling of the heavier casting due to its radiating surface. For example, the casting in Fig. 2, although much heavier than the gear blank shown

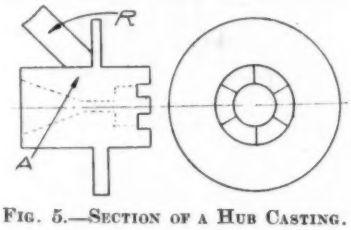

FIG. 5.—SECTION OF A HUB CASTING.

in Fig. 4, undoubtedly will solidify throughout sooner than the gear blank although the latter is much lighter than the former.

The fifth law is fundamental and constantly must be borne in mind in feeding castings. Undoubtedly, in the majority of castings there are certain thick sections that are inaccessible and hence lack solidity unless their cooling is accelerated by artificial means. Reference to Figs. 5, 6 and 7 will show examples of such sections. Many such thick sections either will possess shrinkage cavities or must be artificially chilled if they cannot be fed directly as was done, for example, to feed, and which will solidify after other thinner sections, in the case of the bottom flange *A* of Fig. 3 with a lump feeder.

Referring to the sixth law, the actual top discard by the free use of chills may be reduced and actual shrinkage cavities and lack of density in thick sections may be prevented. Years ago the well known practice of some steel foundrymen of reducing the size of risers and *necking* them so that the castings would appear solid under the riser and yet would be hollow inside was the cause of much jovial comment on the part of some of their competitors, and so far as the author is aware this practice is not tolerated in these days. The frequent use of chills in the author's foundry has reduced the percentage of top scrap by as much as 5 or 6 per cent. and increased the amount of weight going out over the scales in proportion, not to mention the decreased weight of castings returned.

Feeding Large Steel Castings.—In feeding large castings, the use of charcoal, soapstone, sawdust,

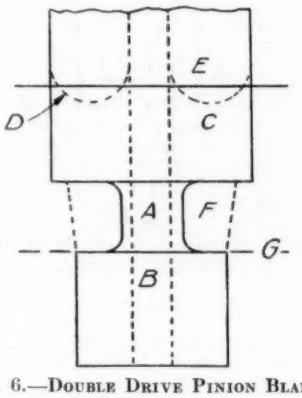

FIG. 6.—DOUBLE DRIVE PINION BLANK.

and other such substances on the top of large risers assists in feeding by retarding the freezing up or solidification of the riser. By the use of iron rods pumped up and down in risers of heavy castings, feeding may be assisted, the riser neck thus be kept open, and the metal prevented from freezing before it settles into the mould. The use of feeding rods in the hands of a strong labourer is of great assistance in feeding both iron and steel castings of large size which may take many minutes to solidify throughout.

The percentage of top discard to the weight of castings may vary greatly for different classes of castings and in different shops. In small gated castings, the weight of gates, runners, and risers may be 200 or 300 per cent. of the weight of the casting. In much heavier castings, the weight of the risers may vary from 8 or 10 per cent. of the weight of the casting up to 50 per cent. How to determine accurately the correct amount of riser necessary to feed given castings often is quite a

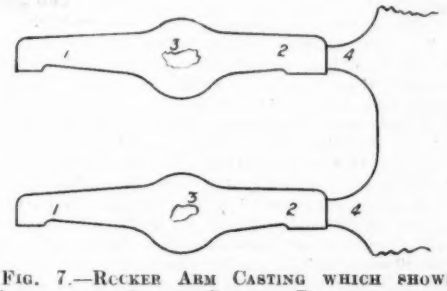

FIG. 7.—ROCKER ARM CASTING WHICH SHOWED SHRINKAGE AT 3 WHEN GATED AT POINTS MARKED 4.

problem, but usually it can be satisfactorily solved by study and experience, leaving, of course, a safe margin of allowance for variation of pouring temperature and other factors not admitting of accurate measurement or control. The percentage of riser provided too often is neglected, and not given the attention required, frequently being left to the moulder or to the guesswork or rule of thumb methods of the foundry foreman or patternmaker. A thorough understanding of the physical laws, which the author has stated in general terms, is necessary for the successful feeding of castings, and yet these rules often are understood only partially and frequently poorly applied, if at all, by foundry foremen. Too often no careful study is given to these problems which are of such vital importance and mean so much in the reduction of foundry costs and maintenance of foundry reputations. Fig. 8 represents graphically the ideal disposition of sections to

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accomplish perfect feeding and solidity. This casting when poured in the position shown in Fig. 2, will be solid in all portions below the top discard, and its several sections will solidify in the order of the numbers indicated, that is, 1, 2, 3, 4, 5, the top scrap solidifying last and containing all of the shrinkage. Fig. 9 illustrates graphically the conditions which prevail in a casting that does not feed perfectly, and hence possesses a decided shrinkage cavity at *A*. The casting poured in the position of Fig. 9 will be solid in its upper half which will solidify as indicated by the numbers, but the lower half will

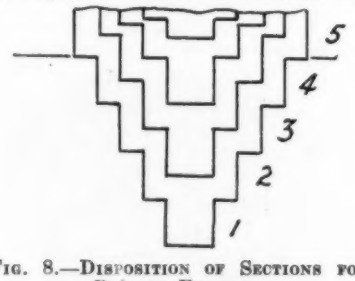

FIG. 8.—DISPOSITION OF SECTIONS FOR PERFECT FEEDING.

be shut off from the source of feed by the solidification of the central sections, 1 and 2, forming the shrinkage cavity at point *A*. If these illustrations are kept clearly in mind and the various sections of different castings adjacent to each other are analysed in the light of these two figures, much shrinkage trouble may be prevented. While the central portions 1, 2, 2, etc., of Fig. 9 will solidify and cut off feed from the source, it must always be borne in mind that by artificial means the solidification of the lower portions, 3, 4, 5, may be accelerated to such an extent that they would solidify before 1, 2, etc., and hence be fed solid. By a study of Figs. 8 and 9 and the laws previously outlined, the fundamental principles of feeding may be understood and applied. The practical application of these principles to the castings made each day, becomes a most interesting, important and fascinating subject. With the infinite variety of castings that are common today, a certain amount of experience with some of the problems of the past is necessary, and even when such experience is possessed, more or less experiment and demonstration by actual tests is required. Making one or more castings, if they are not too large, gating and feeding them in a way believed to be the best, and then rough turning them or cutting them open to see if they are solid is time well spent, and often may prove one of the best of investments.

The writer always has felt that every casting is largely a law unto itself, and there is nothing so satisfying as to know that you have casting conditions correct before starting. The heading and gating of important castings should not be left to the discretion of the moulder, nor should it always be left entirely to the foreman in charge, be he ever so capable. The superintendent should be encouraged to call into conference the patternmaker, the foundry foreman, the chief inspector, and often one or more moulders in mapping out the way in which certain jobs best can be made, and deciding upon the best method to pursue. Frequently the solution for a most knotty and perplexing problem has been suggested by a moulder or patternmaker. When the combined knowledge of all those in charge can be concentrated on a foundry problem, involving these subjects, it is apt to be solved satisfactorily. When a suitable method has been evolved, some routine should be established whereby the decision is recorded and handed down on the records for future reference and benefit. The photographing of such castings, painting of patterns different colours to indicate the location of gates and risers, their size, etc., are valuable aids to foundry operation.

Where space will permit, the shape of a riser usually should be a true cylinder, since solidification takes place in a circle, whether the riser is cylindrical or square. For this reason the corners of a square riser are largely wasted metal. A square riser, 4 in. × 4 in. × 6 in. high, contains 96 cub. in. for feed, and a circular riser of the same diameter as a side of the square and the same height, contains 75.4 cub. in., a saving of 20.6 cub. in. of top discard. The round riser undoubtedly will feed the casting just as effectively as the square riser greater in size. In the author's opinion the most effective height of risers generally has become established as one-and-a-half times their diameter; therefore, a 6-in. riser need not be more than 9 in. high, a 12-in. diameter riser more than 1c in., a 20-in. 30 in. high, etc., to get the maximum result for the minimum expenditure.

Risers may be elliptical, annular or irregularly shaped according to conditions. If it is necessary to make them square or rectangular where they join the casting, they may be necked to cylindrical in shape above that point.

To show the practical working out of some of the general principles of correct feeding which the author has endeavoured to point out, the following typical examples may be of some interest.

Fig. 4 illustrates a simple case of adequate feeding of plain gear blanks, and Fig. 2 is an example of a casting with thin walls and large area exposed to the mould, causing it to solidify so rapidly that little if any feed is necessary after having been poured. In Fig. 4, the risers are little more than what might be called *flow offs* or *pops*, and which only amount to 8 or 10 per cent. of the weight of the casting. The gear blanks of Fig. 4 do not weigh nearly as much as the steel flask of Fig. 2, and yet the blanks will solidify later than the flask if poured at the same time and the same initial temperature, and will take far more feed after pouring but before solidification, therefore, have much more top discard. See the fourth law regarding rates of solidification as previously given.

Fig. 3 shows a tool post successfully gated and fed to obtain perfect castings with a minimum of discard. These castings are machined all over, outside and in, and both flanges then are drilled full of holes so that if defects or shrinkage exists they are certain to be brought to light. Fig. 9 illustrates exactly the condition to be met in the casting shown in Fig. 3. In the illustration, the casting to the right with gate and risers removed

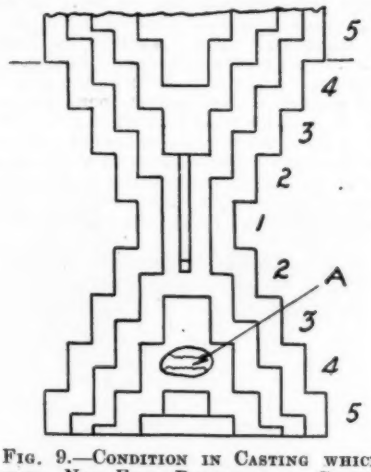

FIG. 9.—CONDITION IN CASTING WHICH WILL NOT FEED PERFECTLY—A CAVITY WILL FORM AT *A*

is inverted when compared with the casting to the left without them removed. The centre riser on top of flange *B* to the left will not feed and take care of the lower flange *A* because the neck between the flanges at the centre of the casting will solidify first, and shrinkage is sure to occur in the lower flange *A*, hence the *blind* or *lump* riser on the lower flange to feed it. The thickness of these castings is such that it was not found feasible to chill the lower flange *A* sufficiently to cause it to solidify before the neck between the flanges.

The hub casting which is shown in Fig. 5 is an example of a thick section which was quite difficult to feed adequately and too thick to chill. These hubs are machined all over, and perfect solidity and clean surfaces were essential. There is no section thick enough to take a suitable riser that would feed the thick portion *A*, shown

in Fig. 5. Therefore, it was necessary to place the riser on the barrel of the casting, as indicated at *R*, and by tilting the mould slightly, clean and solid castings were obtained, although the removal of the riser was somewhat difficult.

A double-drive pinion blank, Fig. 6, is a casting that may be given a great deal of interesting study, both from the standpoint of quality and workmanship, as well as shop costs. If cast on end as shown is a three-part job, the pattern

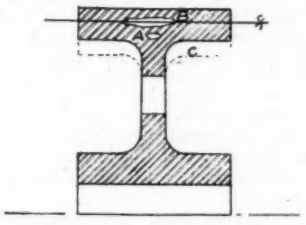

FIG. 10.—SECTION SHOWING SHRINKAGE CAVITIES IN GEAR BLANKS.

having been parted at *G*, but moulded in this way, satisfactory production is not possible. Even when cast in the position shown, the lightening recess desired by the customer, as shown in dotted lines *B*, is in the way of placing either a cylindrical or annular riser. The customer objected to filling in this lightening recess although it amounted to only 4 or 5 per cent. or the weight of the casting. If cast from a split pattern on its side, two risers on cylindrical surfaces would be necessary, and any dirt or shrinkage would occur in the outside diameter where the teeth are cut. Such risers are expensive to remove. The author personally made up five accurate estimates of the exact cost to produce these blanks cast in five different ways, and found that the best and surest, as well as the cheapest, was to cast them in the position shown, with an annular riser *E* and with the addition of metal indicated by the dotted lines at *F*. This made it a job that could be placed on a moulding machine for economic quantity production, all portions of the casing would be perfectly fed, the castings would be free from floating slag or sand, and the excess metal *F* and the lightening panels *D* could be rough turned out by the foundry before shipment at a lower cost than if made in any other way. Without the addition of the extra metal *F* the lower portion *B* would not be solid unless severely chilled or unless fed with a lump riser, which was objectionable for reasons heretofore explained. This casting is a

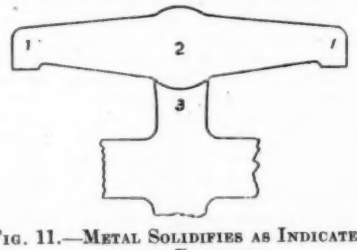

FIG. 11.—METAL SOLIDIFIES AS INDICATED BY THE FIGURES.

striking illustration of the value and economy of careful and critical analysis of all production jobs, not only with a view of getting the best work, but to getting such results at minimum cost.

The Shrinkage Problem.—Gear blanks show examples of some rather troublesome shrinkage to overcome by correct feeding. When the teeth were cut in these castings, shrink holes were uncovered at the base of the teeth opposite the intersections of the web and the rim, in Fig. 10. Shrink holes are indicated in the section, Fig. 10, at *B*. To eliminate these shrink holes by six risers at the intersections referred to would be at the expense of an excessive amount of top scrap, and would cause the castings to crack. To cast them on edge with one riser on the outside diameter would not feed the portions referred to. To cast them on the side with three risers would not feed the three intervening portions or intersections. To chill these portions was not found desirable. Shrinkage holes were prevented by increasing the thickness of the rim of the pattern, as shown by the dotted lines at *C*, Fig. 10, the castings being poured on their sides with three risers and without chills. This added metal resulted in a sufficient retardation of the solidification of the rim, so that the web at the six points of intersection would be fed from the rim. The rim thus remained fluid longer, drawing feed from the three risers to all portions. To check the correctness of the assumption, one casting was rough turned to ¼ in. below the base of each tooth, and all shrinkage had disappeared except one very small hole. This hole has been indicated at *A* in Fig. 10. The effect of thickening the rim, as indicated at *C*, Fig. 10, was to materially retard its solidification, and if shrinkage appears at all, it will be much reduced in size, as shown at *A*, and it will appear below the finished line *F* where it can do no harm.

The small gated rocker arm castings, Figs. 7 and 11, when gated at 4-4 showed shrinkage at 3, the different sections of the castings solidifying in the order of the figures, namely, 1 first, 2 next, 3 last. In this way the thick central section 3 possessed shrinkage holes because there was no source of feed. By gating these castings to the thick central portions, as shown in Fig. 11, with gates sufficiently heavy to provide feed, the order of solidification would be 1-1, 2 and 3, the order desired.

Steel Deoxidisers.

In the course of his address before Section IV. of the recent Engineering Conference at the Institution of Civil Engineers, SIR ROBERT HADFIELD drew attention to the valuable research recently carried out in America upon the action of deoxidation, also with a view to find mixtures or alloys possessing low melting points suitable to act as scavenging oxides. He mentioned that this work had been described in an interesting Paper by Dr. J. R. Cain (U.S. Bureau of Standards), entitled "New Deoxidisers for Steel Manufacture."

No less than seventy-three deoxidising alloys, many of them of possible value to the metallurgist and chiefly to the steel-maker, were shown to have melting points when oxidised somewhat below the melting point of pure iron—some of them considerably below. The conclusions arrived at show that the relative merits of the deoxidisers are determined by those which give deoxidising slags of the lowest freezing point; that is, this type is found to produce the best results.

The cylinders of oxide mixture experimented upon were placed in "Armco" iron crucibles. This is a comparatively pure iron made in the open-hearth furnace on a large scale, also in this country by the Shelton Iron & Steel Company. The melting point of the material, which is iron containing hardly any impurities, is practically the same as that of perfectly pure iron, namely 1,530 deg. C. It was thought that any slags melting at a higher point than the crucibles made of such material containing them would be of no value in the steel industry; consequently, if during the experiments the crucibles of such material showed signs of fusion before their contents, that is of the oxide mixtures, this indicated that it was unnecessary to carry the experiments further.

Sir Robert went on to say that Dr. C. K. Burgess (U.S. Bureau of Standards), in a letter to him recently, stated that the claims put forward with regard to the use of lead-magnesium deoxidisers had been announced prematurely. He mentioned that an alloy containing 94 per cent. lead and 6 per cent. magnesium was introduced experimentally into one or two crucible melts of Armco iron, using the theoretical amounts of magnesium necessary to react with the oxygen. In the Armco iron as determined by the Ledebur method sound ingots were obtained, but thus far no other observations had been made except that it would be found that some desulphurisation took place. The melt, however, gave off large quantities of lead vapour and became oxidised. The lead oxide badly corroded the linings of the refractory crucibles. Further experiments were in progress, the results of which it was expected would shortly be described by the Standards Bureau.

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The Japanese Iron and Steel Industry.

The situation of the iron and steel industry in Japan is discussed by HERR FRITZ RUNKEL, of Bensberg, in a recent issue of "Stahl und Eisen." Since the beginning of 1920, says the author, Japan has been visited by a general economic crisis unparalleled in the past, and due to the reaction of the extraordinarily rapid development during the war. A large number of new works were established in order to cope with the heavy demand for war materials, but they were all organised chiefly for earning immediately huge profits, and had not a strong financial policy like similar European and American concerns; moreover, they lacked the essentials of both economic organisation and technical experience. It is now fully evident that the purchases made by foreigners in Japan were entirely dictated by the urgent necessities of the war, for other countries are not only turning again to the superior European and American products, but in Japan itself there is also a marked tendency to place orders abroad, because they can be purchased more cheaply.

The labour problem in Japan has also entered into a new phase, and the days of cheap labour are past. Before the war the Japanese workmen's wants were few and moderate, while claims for the improvement in working conditions, and particularly for increases in wages, are now the order of the day. To these difficulties has to be added a heavy fall in the prices of iron and steel. Pig-iron, which was quoted at Y. 300 (say £30 at par) at the beginning of 1920, now sells at Y. 80 (say £8), and is said to have even been offered at Y. 62 (£6 4s.). On the other hand, the costs of production are stated to be from Y. 100 to Y. 120 (£10 to £12), and only the large State steel plant at Yawata is said to be able to produce at Y. 90 (£9) the ton.

An improvement in the situation had for a long time been expected from the development of the shipbuilding industry. The tonnage built in Japan in 1920 totalled the combined tonnage constructed in the country during the ten years, 1904 to 1913. But in their excess of zeal the Japanese overreached themselves, and the heavy fall in freights throughout the world brought about a very severe crisis in the shipbuilding industry. Probably the worst mistake committed was that the shipyards, instead of solely satisfying the actual demand, built on speculation a large amount of extra tonnage in the belief of steady continuance of a further upward movement in the demand and prices. Under these circumstances the reaction was all the more brusque, and the state of affairs has since grown so much worse that nearly all the yards in the Osaka district, the most important shipbuilding centre, are now at a standstill. Only about 21 or 22 of the 74 yards which were at work in this district during the war remain in existence, while some of them have been converted to the manufacture of other products.

The iron and steel industry would have been glad to get some help from the Railway Administration. The relaying of the railway tracks from the 3 ft. 6 in. to the standard gauge had long been contemplated, but the carrying out of the change has been postponed indefinitely as the Government does not care to face the expenditure at present. A further result of this policy of the Government is that the extension of the railway system also is only proceeding very slowly despite the heavy increase in the traffic. Some hope of relief may be afforded by the considerable expenditure provided for in the last Budget for the Army and Navy, for which Y.738,281,000 (say £73,830,000) have been set aside out of a total of Y.1,562,000,000 (£156,250,000). Upon the whole, however, the situation is very difficult, and both Government and Parliament are devoting to it increased attention. The measures under consideration are based on the recognition of the fact that, in all endeavours to solve the problem, a close connection must first be established between the iron and steel industry and shipping or shipbuilding. The recommendations made by the Financial and Economic Committee appointed by the Government include the amalgamation of all the groups of works concerned, the introduction of protective duties, the importation of shipbuilding materials free of duty, and the subsidising of home-made steel for shipbuilding purposes. The suggestions even go so far as to advocate the creation of a national shipping trust with Government aid, headed by the Nippon Yusen Kaisha, the largest shipping concern in the country.

The combining of the industrial works meets with difficulties which again are due to the rapid development in recent years. The size and organisation of the different undertakings are too varied and the financial basis shows too wide differences. Nevertheless, the necessity for such a combination has so far been recognised by a special committee entrusted with an examination of the situation, who have recommended the establishment of a community of interests between the leading works in such a form as would practically create a steel trust. A financial participation of the State seems to have been taken into consideration in this connection.

As to the natural basis for an extension of the Japanese iron and steel industry, Herr Runkel states that Japan has at her disposal considerable quantities of coal, only a portion of which, however, can be used for industrial purposes, and will therefore have to be supplemented by imports, chiefly from China. The country, however, lacks large deposits of iron ore, and China again will have to be the most important source. In the author's opinion, however, the extensive ore deposits in the Philippines, said to contain about 500,000,000 tons, will receive the attention of Japanese interests. Special experiments made in Japan for producing steel from volcanic ironsand were mentioned in the Press some time ago. The trials were begun in the autumn of 1920, and are said to have yielded good results, but the process has so far proved too costly for commercial purposes.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Pouring Castings without Runners.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In common with most practical men, I was extremely interested in M. Ronceray's article on the subject of pouring castings without runners, but I feel that Mr. Measures' article would not be complete without some reference to venting.

The only safe method for dispensing with vents is by using a jolt-ram moulding machine. The reason is clear; there is no peg to jam the sand in one place such as a rammer makes when being used by a moulder in hand ramming, or in pneumatic, or in squeezing, or pressure type machines such as hydraulic machines, the action of jolt machines being that, although it is generally assumed that there is merely a jolt ram, which might be termed downwards, there is still a certain amount of vibration created which not only rams, but it also compresses the sand into practically a solid mass and yet retains sufficient porosity to allow for vents. The gardener's method of filling a flower pot is not to press the soil down with the fingers, but to jolt or jar gently the pot with the soil in it on some hard surface, so as to compress the soil down into a solid even mass. It is a simple experiment to take a pot full of ordinary soil, not sifted, and ram it with a peg, and prepare another on the jolt principle, when it will readily be seen on turning the two out that with the peg-rammed one there are certain comparatively large holes, cavities and hard surfaces showing, whereas in the jolt ram there will be none.—Yours, etc.,

GEORGE HALL.

The Croydon Foundry
July 8, 1921.

MR. W. PERRS has been elected a director of the Horseley Bridge & Engineering Company, Limited.

MR. E. A. WILSON has been appointed to the position of chief civil engineer to the Metropolitan Railway Company, in place of MR. W. WILLOX, retired.

Colourimetric Estimation of Phosphorus in Iron and Steel.

The ammonium-molybdate method is the one generally used in the estimation of phosphorus in steels. Some analysts weigh the yellow phospho-molybdate precipitate directly, either after drying at 100 degs. cent. and using the factor 1.65, or after lightly calcining and using the factor 1.75. Certain analysts titrate the precipitate after washing with dilute nitric acid, and finally others measure the volume of the precipitate after centrifuging. These different modifications give accurate results. M. G. Misson, chief chemist to the Société Cockerill at Seraing, who originated the colourimetric method, previously used the light calcination process, and the analysis took him 22 to 25 minutes, states *Annales de Chimie Analytique*, in a review of Misson's work. The method which he has now worked out presents no difficulties in manipulation, and gives a result in ten minutes. It is based upon the yellowish-orange colouration produced when an excess of ammonium molybdate solution is added in the cold to a dilute solution of phosphorus and vanadium in nitric acid, a colouration the intensity of which is proportional to the amount of phosphorus present. The actual compound formed is ammonium vanado-phospho-molybdate, containing 1.25 per cent. of phosphorus and 2.10 per cent. of vanadium. This compound is soluble in dilute aqueous liquids.

Preparation of Reagents.—The reagents employed are: Nitric acid, specific gravity 1.20, and free from chlorine; a 0.8 per cent. solution of potassium permanganate; a solution of oxygenated water free from chlorine and phosphoric acid, prepared by mixing 900 c.c. of distilled water with 100 c.c. of pure nitric acid and 40 grammes of sodium peroxide; a solution of ammonium vanadate prepared by dissolving 2.345 grammes of ammonium vanadate in 500 c.c. of hot distilled water, adding to this solution 20 c.c. of concentrated nitric acid, and making up to one litre after cooling; and a 10 per cent. solution of ammonium molybdate freshly prepared.

One gramme of the steel to be analysed is weighed out accurately into a 100-c.c. conical flask, which is graduated by a mark indicating 80 c.c. The steel is dissolved by nitric acid (sp. gr. 1.20), and the solution boiled, when 10 c.c. of the permanganate solution are added. The boiling is continued for two minutes, so as to destroy the organic matter. 10 c.c. of oxygenated water are added to dissolve any manganese oxide, then 10 c.c. of the ammonium-vanadate solution. The solution is then boiled again to eliminate the excess of oxygenated water, and finally 10 c.c. of the ammonium-molybdate solution are added. The solution is cooled and made up with water to the 80-c.c. mark. After shaking, the solution is compared with standard solutions made in the same way from steels containing accurately determined amounts of phosphorus. This colour comparison is best made in Eggertz tubes, such as are used in the estimation of carbon.

Phosphorus by weighing.	Phosphorus by Misson's Method. I.	II.
Per cent.	Per cent.	Per cent.
0.085	0.080	0.082
0.060	0.065	0.060
0.063	0.070	0.070
0.056	0.050	0.052
0.073	0.070	0.072
0.070	0.065	0.064
0.100	0.105	0.100

The standard solutions should be prepared with the greatest care. M. Misson usually employs nine solutions, the first of which is made from steel with a phosphorus content (determined gravimetrically) of 0.02 per cent. To this solution is then added the quantities of phosphorus necessary to obtain solutions containing 0.03, 0.04, 0.06, 0.08, 0.10, 0.12, 0.15, and 0.18 per cent. of phosphorus. This phosphorus is added in the form of a standard ammonium-phosphate solution, of which 1 c.c. represents 1 milligramme of phosphorus.

The steel standard solutions containing the additional phosphorus keep several days, but should generally be freshly prepared every week.

The tints of the solutions containing the above-mentioned amounts of phosphorus present differences which render very accurate colourimetric comparison possible; in fact, results accurate to within 0.005 per cent. can be obtained even by inexperienced operators. Results obtained in the analysis of several steels, both by the gravimetric molybdate process and by the Misson colourimetric process, are given above. The first figures of the colourimetric method were given with freshly prepared standard solutions, and the second with standard solutions a fortnight old.

Procedure for Irons.—M. Misson has recently extended his methods to various types of cast iron (*Bulletin de la Société Chimique de Belgique*, October, 1920). The same reagents are employed as in the case of the steel analysis.

For Bessemer iron he recommends attacking 5 grammes of the iron with 60 c.c. of nitric acid (sp. gr. 1.20) in a wide-necked 250-c.c. flask. The flask and its contents are heated on a sandbath until the reaction is completed, when the contents are transferred to a graduated 100-c.c. flask. After making up to the mark, the contents of the flask are shaken and filtered. 8 c.c. of nitric acid (sp. gr. 1.20) are now added to 20 c.c. of the filtrate, and the analysis proceeded with as in the case of steel, paying attention, however, to the quantity of combined carbon in the sample of iron. According to the tint of the solution, from 0.5 to 1 gramme of potassium permanganate in 10 c.c. of water is added, and the excess of permanganate is destroyed by the addition of oxygenated water of double the strength used in the steel analyses. The colour comparison is made with the same type solutions as serve for the estimation of phosphorus in steels.

When dealing with spiegeleisen, 0.5 gramme of the iron and 0.5 gramme of steel containing 0.2 per cent. of phosphorus are treated in an 80-c.c. conical flask with 20 c.c. of nitric acid (sp. gr. 1.20), and boiled until the reaction is completed. 0.5 gramme of potassium permanganate dissolved in 10 c.c. of water is added, and an oxygenated water of double the strength desirable for steel analysis destroys the excess of permanganate.

With basic iron, 0.50 gramme of the sample is treated with 50 c.c. of boiling nitric acid (sp. gr. 1.20) in a 125-c.c. flask. After the reaction is finished, the flask is cooled and made up with water to the 125-c.c. mark. 25 c.c. of the liquor is now transferred to a 110-c.c. conical flask, and the operation continued as for the steels. A double portion of ammonium-vanadate solution—*i.e.*, 20 c.c.—is, however, added. After the addition of the ammonium molybdate and cooling, the volume is made up to 110 c.c., the flask well shaken and allowed to rest for one hour, so that it is at atmospheric temperature, as are the standard solutions. The standard solutions necessary are prepared from a cast iron containing 1 per cent. of phosphorus and enriched by means of standard ammonium-phosphate solution to contain 1.5, 1.9, 2.3, and 2 per cent. of phosphorus. The results obtained agree to within 0.05 per cent. with those obtained by the gravimetric method.

For irons containing from 0.2 to 1 per cent. of phosphorus, the procedure is somewhat different. 2 grammes of the sample are treated with 120 c.c. of nitric acid (sp. gr. 1.20) in a flask covered with a watch glass and boiled until the reaction is completed. (This test serves at the same time for the estimation of the graphite.) After filtering off the graphite through a Gooch crucible and washing this latter with nitric acid (sp. gr. 1.20), the filtrate is transferred to a 200-c.c. graduated flask and the volume made up to 200 c.c. with the nitric acid. 20 c.c. of this solution are now taken and transferred to a conical flask of 100 c.c. capacity. 0.80 gramme of steel containing 0.02 per cent. of phosphorus is added and dissolved by heating, and the operation is continued as usual. The tint is compared with those of the standard solutions serving for the examination of steels. The figure found is reduced by 0.016 gramme (corresponding to the amount of phosphorus introduced in the steel), and the remainder is multiplied by 5. The results obtained closely agree with those given by the yellow ammonium—phospho-molybdate precipitate method.—*Chemical Trade Journal and Chemical Engineer.*

XUM

Trade Talk.

THE CHINESE GOVERNMENT, it is reported, has placed an order in Belgium for 36 engines and 240 wagons.

RUTTERS BROS. & COMPANY, LIMITED, of Glasgow, have received an order for steam cranes from a foreign Government to the value of over £25,000.

T. ROWLANDS & COMPANY, LIMITED, of Sheffield, have now left their North Church Street offices and entered into new premises at 27, Broomhall Street.

CONSIDERABLE DAMAGE has been caused by a fire which occurred at the works of Messrs. Hall, Lewis & Company, metal, scrap and machinery merchants, Cardiff.

SAMUEL OSBORN (CANADA), LIMITED, a branch of the Sheffield firm, has just opened an office and warehouse at Cobalt, to take care of the Northern Ontario mining business.

THE DIRECTORS OF THE TATA COMPANY are negotiating for the establishment of plants for building railway wagons and locomotives, and the manufacture of agricultural implements, wire products, sheets, wire ropes, etc. It is expected that these and other plants will ultimately be established at Jamshedpur.

BECAUSE OF THE EXCESSIVE HEAT, thousands of operatives engaged in iron, bolt, and chain works in the Black Country ceased work last week, many collapsing in front of the fires.

THE THORNCLIFFE IRONWORKS COMPANY, of Messrs. Newton Chambers & Company, Limited, are reported to be starting up their blast furnaces, as supplies of coke are now coming through.

THE Ministry of Labour states that the preliminary returns from the live registers of the employment exchanges for July 1 show a fall of 9,172 in the number of unemployed compared with the returns for June 24.

THE LONDON OFFICES of Tilghman's Patent Sand Blast Company, Limited, and Geo. Richards & Company, Limited, Broadheath, near Manchester, have been removed to 17, Grosvenor Gardens, London, S.W.1.

THE ascertained price of West Coast hematite pig-iron for the three months ended June 30 is £10 1s. per ton and blast-furnacemen's wages are reduced 51¾ per cent. and are now only 163¾ per cent. above standard.

THE furnaces at the Port Talbot Steelworks, where nearly 2,000 men are employed, have been relit after a prolonged stoppage, and it is hoped that work will shortly be restarted in the mills and other departments.

THE Mersey Docks and Harbour Board report that during the twelve months ended July 1 21,203 vessels, of a total tonnage of 15,813,126, entered the port, compared with 17,115 vessels of a tonnage of 16,521,373 in the previous year.

THE DISPUTE with the laminated spring workers of Sheffield has been settled at a conference between representatives of the employers' association and of the trade union concerned, the men agreeing to accept reduced rates of pay.

COMPANY REGISTRATIONS AT SOMERSET HOUSE during the first half of the present year, included 191 engineering companies, with a capital of £1,310,990, 190 iron, brass, etc., concerns with a capital of £2,771,500, and 85 mining companies having a total capital of £4,332,650.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have launched at Newcastle-on-Tyne the steamer "El Oso" for the Lobitos Oilfields, Limited. The vessel is designed to carry 10,175 tons, and when loaded to have a speed of 11½ knots.

IT IS ANNOUNCED that Messrs. William Gray & Company, shipbuilders, of West Hartlepool, will this year distribute £31,784 to 4,262 employés under their profit-sharing scheme. Only 17 per cent. of the employés are disqualified, against 35 per cent. last year.

SEVERAL MORE WELSH steel and tinplate works have re-started, thus finding work for thousands of men. Many works have considerable orders in hand, accumulated since the coal stoppage, and these are largely for the Continent and Far Eastern account. Japan being a large buyer.

SHEFFIELD CITY COUNCIL last week refused to confirm the Electric Supply Committee's proposal to purchase electrical plant from Germany at a cost of £49,000, and referred the proposal back for further consideration. The lowest British quotation was between £90,000 and £100,000.

CHRISTMAS, HULBERT & WALTERS, LTD., of London and Sheffield, have been formed by Messrs. E. B. Christmas and A. Walters, both recently directors of the International Construction Company, Limited, and Mr. J. C. Hulbert, recently of Gastons, Limited, to manufacture the products of the Blaw-Knox Company, of New Jersey, Pittsburgh, etc. The new company will control exclusively the products and patents of the American company. An interesting speciality of the company will be collapsible "Blawforms," which entirely replace timber in concrete constructions.

THE first blast-furnaces to be lighted up since the resumption of work at the coal mines have been started at Messrs. Bell Brothers' Clarence Works, where two of the furnaces have been put into operation for the production of pig-iron for use in the steel plant.

THE "Gunga," launched recently by William Simons & Company, Limited, to the order of the Commissioners for the Port of Calcutta, is the largest dredger yet built on the Clyde, and is 370 ft. in length by 57 ft. 6 in. by 24 ft. 6 in., with a hopper capacity of 80,000 cubic ft.

A REPORT FROM JARROW states that the amalgamation of the Boilermakers', Shipwrights', and Blacksmiths' Societies, which has been in temporary operation during the past year, has now been definitely ended. The boilermakers and blacksmiths will ballot on amalgamating their unions.

THE DIRECTORS OF THE English Crown Spelter Company, Limited, announce that as the refund of Excess Profits Duty for 1920 has been received from the Government, the first mortgage debentures issued to Lloyd's Bank, Limited, as authorised on February 28 last, have now been paid off.

AN ENJOYABLE FUNCTION recently took place when the staff of the Brightside Foundry and Engineering Company, Limited (together with their womenfolk), held their second annual garden party in the grounds of Prior Bank, Sheffield, the residence of Mr. T. H. Firth, managing director of the company.

AT A MEETING of the various unions of the men employed in the lighter steel trades in Sheffield recently, a resolution was carried, with few dissentients, recommending the acceptance of the proposed bonus reductions which are to operate from August 2. These reductions affect about 4,000 workers.

THE HAUTS FOURNEAUX DE LA CHIERS have started work in their basic-Bessemer plant, and the reversing mill in connection therewith. This is the third basic-Bessemer plant re-started in the devastated Longwy region, the other two concerns being La Providence, at Rehon, and the Senelle-Maubeuge, at Senelle.

FRANK MOTT & COMPANY, LIMITED, of Billiter Square Buildings, London, E.C., have made arrangements whereby they will in future deal with all matters concerning tramway rails, manufactured by the Phœnix Works, in Germany, so far as inquiries and orders emanating from the United Kingdom are concerned.

AN OFFICIAL of the National Iron and Steel Manufacturers' Federation states:—"There is a large world demand for steel, but it is potential rather than actual at the present. The whole thing is a question of price. Coal at 20s. a ton, or some say 15s. per ton, would go a long way to convert that potential into an actual demand.

BELFAST SHIPBUILDING FIRMS have submitted a proposal to the engineering and shipbuilding trades unions for the withdrawal of the Ministry of Munitions bonus of 12½ per cent. for time workers and 7½ per cent. for piece workers, the method of withdrawal to cover a period of five months in instalments of 2½ per cent. and 1½ respectively.

UNDER the sliding scale by which blast-furnacemen's wages on the North-East Coast are regulated by the selling price of Cleveland pig-iron, there will be an unprecedented wage cut during the ensuing three months, amounting to 71½ per cent. Three months ago there was a drop of 26½ per cent., making 97½ per cent. for the year.

GRANTHAM ENGINEERING APPRENTICES employed at Spittlegate Ironworks (Messrs. Ruston & Hornsby, Limited) have struck work rather than accept reductions of 1s. per week now, 1s. in a month, and 2s. in September (under age 17), and 2s. 6d. now, 2s. 6d. in a month, and 5s. in September (over 18). The strikers number nearly 300.

WILLIAM BEARDMORE & COMPANY, LIMITED, Parkhead, Glasgow, propose re-opening certain departments at the end of the Fair holidays. Sections which depend upon gas plant will be first opened, beginning on July 27, while other departments will follow as supplies of coal are forthcoming. The steel works are expected to start about the beginning of August.

SPECIFICATIONS IN CONNECTION with a call for tenders by the Chilian State Railways for rails, accessories, crossings, etc.; foundry coke and tin bars, to the estimated value of £300,000, have been received from the Commercial Secretary to H.M. Legation at Santiago, Chile, and can be inspected on application to Room 50, Department of Overseas Trade, 35, Old Queen Street, S.W.1.

THERE has been a threatened strike of casters in the malleable iron foundry trade at Walsall, two firms in the town having given notice that two advances last year, in April and June, of 3s. per week to day workers and 7½ per cent. to piece workers were to be withdrawn, one advance immediately and the second in two months' time. As a result of a subsequent conference, the masters agreed to modify the terms of the reduction, so that they will come into operation in three, instead of two, stages. This has been accepted by the employés and work has been resumed.

Company News.

Engineers & Exporters, Limited.—Capital £5,000 in £1 shares.

Chesterfield Tube Company, Limited.—Interim ordinary dividend, 7½ per cent.; no final dividend; profit, £43,185; carried forward, £10,560.

Hall & Company (Sheffield), Limited.—Capital £1,000 in £1 shares, to carry on the business of iron and steel manufacturers and merchants, etc.

Greenwood & Batley, Limited.—Final ordinary dividend, 2½ per cent., making 5 per cent. for year; preferred dividend, 3½ per cent., making 7 per cent.

Gloucester Railway Carriage & Wagon Company, Limited.—Dividend for half-year, 10 per cent., making 10 per cent. for year, less tax; bonus, 5 per cent., free of tax.

Clyde Gears, Limited.—Capital £2,000 in £1 shares, to acquire the patent rights of "Clyde" reverse gears for marine motors. Registered office: 15, Thornhill, Johnstone.

Wm. Roberts (Tipton), Limited. — Profit, £7,842; brought forward, £2,302; available, £10,144; final ordinary dividend, 5 per cent. (free of tax), making 5 per cent. for year; carried forward, £6,224.

Whessoe Foundry and Engineering Company, Limited.—Profit, £38,621; depreciation, £7,617; reserve, £905; preliminary expenses, £2,308; dividend, 10 per cent. free of tax; carried forward, £7,792.

General Electric Company, Limited. — Net profits, £788,149; brought forward, £175,668; ordinary dividend, 10 per cent., free of tax; depreciation, £157,915; pension fund, £17,266; carry forward, £348,094.

Tredegar Iron & Coal Company, Limited. — Profit, £145,128; amount brought forward, £26,455; depreciation, £10,000; A and B dividend, 10 per cent., free of tax, of which 5 per cent. paid December last; carry forward, £37,933.

Darlington Forge Company, Limited. — Profit, £34,628; brought forward, £12,105; preference dividend, 7 per cent. for half-year, £17,850; final preference dividend, 7 per cent., £17,850; charitable subscriptions, etc., £500; carried forward, £10,533.

Leadbeater & Scott, Limited.—Capital £30,000 in £1 shares, to take over the business of steel and file merchant and manufacturer carried on at the National Works, Bath Steel Works, and the St. Mary's Works, Penistone Road, Sheffield, by J. Wing, as Leadbeater & Scott.

W. & T. Avery, Limited.—Profit, including amount brought forward, £95,890; disposable surplus, £77,017; final ordinary dividend, 10 per cent. (less tax), making 15 per cent. for year; new issue ordinary dividend, 7½ per cent. (less tax); reserve, £20,000; carry forward, £25,020.

Victoria Electrical (Manchester), Limited. — Capital £6,000 in £1 shares, to take over the business of an electrical engineer, contractor, etc., carried on by J. R. Reef as the Victoria Electrical Company in London and Manchester. Registered office: 27, Berry Street, Buxton Street, London Road, Manchester.

Allen Everitt & Sons, Limited. — Profit, £22,187; brought forward, £9,638; depreciation, £9,663; reserve, £460; debenture interest, £4,014; interim dividend on preference and ordinary, £6,600; final dividends, 6 per cent. per annum, less tax, on preference (making 6 per cent. for year), and 7½ per cent. per annum, free of tax, on ordinary (making 7½ per cent., free of tax, for year); carry forward, £4,537.

Personal.

MR. F. J. COOK, well-known in foundry trade circles in the Midlands, is suffering from appendicitis.

THE LATE MR. F. E. MUNTZ, chairman of the Horseley Bridge & Engineering Company, of Tipton, Staffs., has left £329,712.

MR. H. COVENTRY, who has been connected with the business of Messrs. Sim & Coventry, Liverpool and London, for many years, has been taken into partnership.

MR. A. E. BOND, a director of J. C. Abbott & Company, Limited, has been elected to fill the vacancy on the board of Wm. Roberts (Tipton), Limited, caused by the death of the late chairman.

CAPTAIN HAYES, Bedford Park, London, and his little daughter recently had a fortunate escape from drowning at Sandown. They were upset in a canoe, and were in a critical position when Mr. Nelson, from Kingston-on-Thames, jumped from his canoe and rescued the father, the daughter being saved by two other swimmers.

MR. M. SOLOMON has been elected managing director of the Pirelli-General Cable Works, one of the allied organisations of the General Electric Company, Limited, and has resigned his seat on the board of the latter company. MR. M. S. CONNER, formerly managing director of the Peel Conner Telephone Works, which is now the property of the G.E.C., has joined the board.

Gazette.

A RECEIVING ORDER has been issued in the case of Mr. David Russell, carrying on business as D. Russell & Company at Suffolk House, 5, Laurence Pountney Hill, E.C., iron and steel merchant.

MESSRS I. OSMAN and F. Osman, engineers and machinists, Pershore Road, Stirchley, Birmingham, trading under the style of the Empire Engineering Company, have dissolved partnership.

AT A MEETING of the creditors of Alfred Harrison, an iron and steel merchant, 4, Broad Street Chambers, Sheffield, the causes of failure were said to be trade losses and depression in trade and slump in steel prices.

THE PARTNERSHIP previously subsisting between Messrs. G. W. Sheppard and J. W. Smith, trading as Sheppard & Smith, 23 and 25, Moorgate Street, Leicester, metal merchants, has been dissolved. Debts by Mr. G. W. Sheppard.

THE FIRST MEETING of creditors was held in London on July 7 under a receiving order made against Mr. H. N. Knights, engineer and contractor, of 43, King William Street, London, E.C. The Official Receiver read over proofs of debt aggregating £56,000. The largest proof was that of the National Bank of South Africa, for £49,167, less securities valued at £15,675. The debtor, in 1911, bought the Astbury Engineering Works at Peckham. His business was very successful until April, 1920, when there was a heavy fall in the price of metals. During the war he had worked for the Government, but had made no profit. He valued his assets at £3,150. The creditors decided to make an application for an order adjudging the debtor a bankrupt, and that Mr. S. P. Child be appointed trustee of the estate.

Deaths.

MR. R. TAYLOR, senior partner in the firm of Messrs. Richard Taylor & Sons, metal merchants, Cross Street, Bury, died recently in his 51st year.

MR. JOSEPH SIDNEY SEAMAN, for nearly 65 years identified with the iron and steel foundry industry of the United States, the oldest living past president of the American Foundrymen's Association, and chairman of the board of the Pittsburgh Rolls Corporation, Pittsburgh, died June 15 at his home in Pittsburgh. He was 82 years old.

MR. T. F. WARD, of Park Road, South, Linthorpe, Middlesbrough, has died at the age of 78, after a protracted illness. Mr. Ward was one of the pioneers of industry on Tees-side. Forty years ago he joined the firm of Sir B. Samuelson & Company, Limited, of which he became a director, and head of the commercial department.

MR. R. WALBER, chairman of Robert Walber, Limited, iron and steel merchants, West Ferry Road, Millwall, London, E.14, died recently at the age of 61. The company was converted into a limited liability concern just before the war, and in 1914 Mr. Walber became chairman and managing director.

MR. A. C. ROGERSON, general manager of Beyer, Peacock & Company, Limited, died suddenly on the 10th inst. in his 53rd year. Mr. Rogerson had been in indifferent health for some years past, and never fully recovered from a breakdown which took place shortly after the Armistice, through constant overwork in the later years of the war. During the war his great organising ability had shown itself by the success with which he had adapted the resources and technical knowledge of his firm to the manufacture of certain highly specialised war material. For those services he was awarded the C.B.E., but his health had meanwhile given way under the strain.

THE JUNE ISSUE of "Economic Intelligence," a Dutch Government publication, printed in English, contains a complete list of the members of Co-operative Associations of Dutch Iron Foundries.

MR. R. A. BARTRAM, shipbuilder, has offered to give 10,000 guineas for the endowment of four scholarships at the Technical College, Sunderland, open to students from local shipyards and engineering establishments, and to construct and equip a drawing office for naval architects at the Technical College.

SIR WILLIAM JOSEPH NOBLE, BART., has been elected president of the North-East Coast Institution of Engineers and Shipbuilders for the coming year. The vice-presidents include Mr. C. W. Cairns, superintendent engineer, Cairns, Noble & Company, Limited, Newcastle-on-Tyne; Mr. A. Laing, general manager and director, Wallsend Slipway and Engineering Company, Limited, Wallsend-on-Tyne; Mr. C. D. Smith, managing director, Thos. and Wm. Smith, Limited, Newcastle-on-Tyne; and Mr. R. Wallis, works manager, Wallsend Slipway and Engineering Company, Limited.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

The aspect of the pig-iron trade at the moment gives but faint hopes of an early revival of activity, and although during the past week a couple of furnaces in the Cleveland district were re-lighted, there is little prospect of a general resumption of production being immediately realised. Fuel is, of course, the main factor in the situation, and until coke in ample supplies is available at proportionately reasonable prices, ironmasters may be excused for declining to run plants at a dead loss. Even with the substantial decline in blast-furnacemen's wages rates recently authorised, at present costs of raw materials and fuel producers cannot place iron on the market at prices to meet Continental competitors on equal terms, and until these conditions materialise the furnaces will be confined in output to qualities suitable for their associated steelworks. The position thus outlined tends to restrict market operations to the minimum, makers havng only very limited supplies of foundry iron, with a consequent tendency to advanced prices for the quantities available. Business is, therefore, for the time being practically suspended in all pig-iron markets, and in the opinion of most members of the trade no revival of activity is likely before the autumn. By that time probably the question of productive costs will be definitely settled, and should a substantial decrease of prices of raw materials and fuel be effected, a steady recovery in the iron trade would inevitably follow. Meanwhile the official minima are all unchanged, No. 1 being nominally at 125s. per ton, No. 3 Cleveland G.M.B. 120s., No. 4 foundry 119s., No. 4 forge and mottled 117s. 6d., white iron 115s. The actual selling prices however, differ widely from the minimum in many cases. There is no No. 1 to be got; for No. 3 and No. 4 foundry iron 135s. is the uniform figure, consumers having to take equal proportions of each, and they have notice of a 5s. per ton advance next month. Moreover, a premium of 5s. per ton is levied on all foundry iron for export, so that the present price to the foreigner is £7 per ton.

East Coast hematite, which is fairly plentiful, is offered for export at the same figure as foundry iron, viz., 140s. per ton, but to home buyers the price of mixed numbers is still 160s. per ton. In West Cumberland and North Lancashire the hematite iron industry continues at a standstill, the limited business transacted being confined to the sale of occasional parcels, the prices for which are usually a matter for negotiation.

Steel.

Some signs of returning activity in the steel trade are now perceptible in Sheffield, a few of the works having re-started during the past week, the mills having a fair tonnage of rolling in hand for home consumers, while the forges can also claim an average number of orders for the lighter classes of material. The steel foundries are renewing operations with a fair volume of orders on the books, a few of the acid open-hearth furnaces are at work, but many of the large open-hearth furnaces still remain idle, conditions maintained for some months past. Business in most branches of the steel trade, however, continues depressed, as emphasised in the latest Board of Trade returns, British steel exports showing a further substantial decrease, the value of shipments overseas of implements and tools for June having fallen from the previous month from £560,511 to £277,190. Finished steel exports also show a heavy loss; special steels were only one-fifth of the June, 1920, total, and railway material dropped from 19,851 tons to 7,239 tons. During the month of June, Belgium sent to British ports 3,299 tons of billets and 1,466 tons of constructional steel, while among other items in the list are 4,082 tons of tram rails, 108 tons of axles and tyres, and 99 tons of railway wheels and axles complete. In the West of Scotland steel trade, the annual holidays have already started—which is a week sooner than usual—and will probably extend a week longer than usual also. Current quotations for industrial fuel offer no inducement to accelerate a resumption of work, while few orders have been booked since the beginning of the coal strike. On the North-East Coast, the steelworks are gradually starting up the mills, but the resumption of work is only partial, and it is very difficult to book orders. Buyers continue to hold off a falling market, and prices generally are inclined to droop. Railway steel departments are far better equipped than ever they have been, but the orders on hand are comparatively light. Stores departments are buying on the hand-to-mouth principle, in the belief that prices will fall before long. There has been an easing of prices, but they are still very high in comparison with the prices quoted by Continental and American makers.

Tinplates.

There are few signs as yet of a recovery in the tinplate trade, only a few mills having so far re-commenced operations, makers, as a body, deferring a resumption of work until there is some prospect of producing on a profit basis. The market meanwhile continues lifeless, and with only a limited volume of inquiries coming to hand, little actual business can be reported. The demand, as a rule, is confined to stock parcels, for which about 27s. to 27s. 6d. is quoted as the basis for ordinary sizes. Wasters are in quiet request; CW. 28 by 20, at round 40s.; CW. 14 by 20, at 20s.; CW. 14 by 18¾, at 16s. 6d. All net cash, f.o.t. at works. Terneplates are quoted nominally 26s. basis, but there is not sufficient business to test the market. An actual order would probably be taken at 25s. or less, for September onwards.

Finished Iron.

If that time-honoured institution, the Birmingham quarterly meeting, may be accepted as an index to conditions in the finished iron trade, it will be generally conceded that last week's gathering afforded very little encouragement to an optimistic view of the position, and was, in fact, a most disappointing event both in the number of members in attendance, and the volume of business transacted. There were, however, as a compensating feature, numerous inquiries, but the actual business resulting was by no means satisfactory, buyers being evidently determined to withhold orders in the hope of securing more advantageous terms later. To some extent this policy was justified by a subsequent announcement of a further reduction of £2 in the price of marked bars, which may be regarded as the most important feature of the meeting. This places the standard on the £20 basis, the same price as quoted for iron strip. Makers of the last-named material are, however, idle at present, while unmarked bars at £16 are neglected, except for varied specifications received from merchants to supplement depleted warehouse stocks. Nut and bolt manufacturers have only enough work to employ them a day or two a week. They are under no necessity to buy raw material; if they were they could get Belgian bars at something like £11, delivered in the Black Country; so that there is not much inducement to re-start bar mills with a view to orders from the nut and bolt trade. Chain and cable makers are doing very little. There is hardly any demand for the special iron which they employ.

Scrap.

Conditions in all sections of the scrap trade remain as quiet as recently reported, very little business being possible in present circumstances with buyers everywhere increasingly reluctant to entertain any fresh commitments. Foundrymen, usually considerable consumers of this class of raw material, are not in the market at the moment, while even the low prices now quoted for all descriptions of scrap fail to tempt buyers to any appreciable extent. In South Wales supplies are fairly plentiful, but in the continued absence of any active demand prices must be considered nominal. Heavy steel scrap is available in large quantities at between 60s. to 80s. Steel turnings are offered at 40s. to 60s., bundled steel scrap and shearings are quiet at 50s. to 80s., according to the method adopted in bundling, and heavy cast-iron scrap in large pieces and furnace sizes is firmer at 60s. to 90s. Good machinery scrap for foundry purposes is quoted at about £6 per ton.

Metals.

Copper.—Messrs. Henry Bath & Son, Limited, in their fortnightly metal report, under date July 15, 1921 state:—During the past fortnight the cash price of copper has fluctuated between £71 12s. 6d. and £72 12s. 6d., and three months between £71 15s. and £72 15s., until to-day, when prices dropped 12s. 6d. to 15s. per ton. The average daily turnover has been small. The home demand has continued on a restricted scale, although it is understood that stocks at the works are very low. A better demand has been experienced occasionally in America, but on the whole orders are scarce and keenly competed for. Reports are being received from many parts of the world of increased activity in electrification work, including railway and tramway undertakings and power and light installations. According to the Metal Exchange returns, the stocks of copper in warehouse on June 30 were 13,042 tons refined, 6,386 tons rough, and 228 tons unclassified, together 19,656 tons, against a total of 19,465 tons on May 31. Closing prices:—Cash: Wednesday, £72 2s. 6d.; Thursday, £71 12s. 6d.: Friday, £70 17s. 6d.; Monday, £70 10s.; Tuesday.

£70 2s. 6d. Three Months: Wednesday, £72 5s.; Thursday, £71 15s.; Friday, £71 2s. 6d.; Monday, £70 17s. 6d.; Tuesday, £70 10s.

Tin.—After advancing for the first two days of the fortnight to £172 5s. cash and £174 5s. three months, the improvement was lost, practically all in one day, and the subsequent fluctuations have been very small.

Bear covering has been in evidence daily.

America bought early on in anticipation of the contemplated imposition of an import tariff on tin to take effect in September, but has since apparently retired from the market.

Some more Welsh tinplate works have reopened, but they are experiencing a disappointing demand for the article, large stocks of which lie heavy on merchants' hands.

The East has sold moderate quantities at reduced prices. It is understood that the arrangements between the Federated Malay States and the Netherlands to withhold from the market their respective stocks of tin has been extended for a further period. Closing prices:—Cash: Wednesday, £166 15s.; Thursday, £166 5s.; Friday, £165 10s.; Monday, £164 10s.; Tuesday, £161 10s. Three Months: Wednesday, £169; Thursday, £168 5s.; Friday, £167 15s.; Monday, £166 15s.; Tuesday, £164.

Lead.—This market has remained firm throughout with little change in prices. Consumption has been moderately satisfactory, but consumers are not buying forward to any extent, and continue to live from hand to mouth. Supplies have been a little larger lately, including a parcel from Italy and some quantities of American lead are said to be en route to this country, also a shipment of 500 tons from Australia is recorded, which is the first for a long time from this quarter. The Metal Exchange returns show stocks on June 30 as 13,278 tons, against 14,138 tons on May 31, a decrease for the month of 860 tons. English closing prices:—Wednesday, £24 10s.; Thursday, £24 10s.; Friday, £24 15s.; Monday, £24 15s.; Tuesday, £24 15s.

Spelter.—Hardly any movement in price worth recording has taken place during the fortnight, until the closing days when a decline set in. On some days no transactions took place at all on the market. Trade with consumers has not been entirely unsatisfactory, and although arrivals have been small, stocks are ample for present requirements. The Metal Exchange returns show a decrease in stocks of 248 tons, the figures being 18,752 tons against 19,000 tons on May 31. Closing prices:—Wednesday, £26 17s. 6d.; Thursday, £26 10s.; Friday, £26 10s.; Monday, £26 10s.; Tuesday, £26 10s.

Miscellanea.

LLOYD'S REGISTER SHIPBUILDING RETURNS for the quarter ended June 30 show that the merchant tonnage under construction in the United Kingdom at the end of June was 3,530,047 tons, a reduction of about 269,000 tons compared with the previous quarter. The total includes 735,000 tons on which work had been suspended and 440,000 tons delayed in completion.

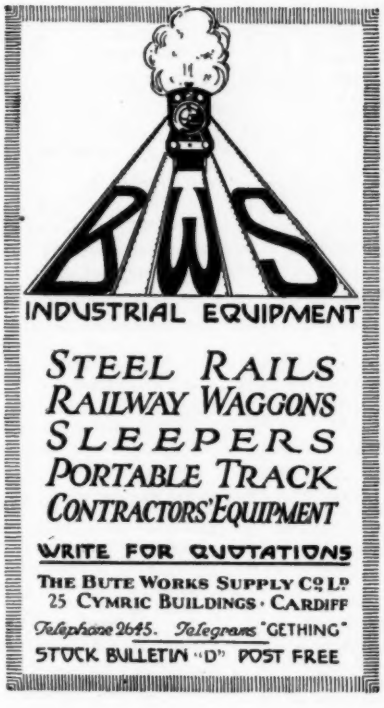
THE engineers' ballot on the wages reductions proposed by the employers has resulted as follows:—For acceptance, 175,145; against, 108,969; majority for acceptance, 66,176. The reductions take effect in stages—3s. per week and 7½ per cent. on piecework prices at once and a similar cut on August 15. A third stage is to be the subject of conference in September.

MR. A. H. GLEDHILL, managing director of Gledhill Brook Time Recorders, Limited, Huddersfield, has just had his claim for royalties for bomb-dropping gear before the Royal Commission dealing with war inventions. Contracts amounting to £195,000 were placed during the war, and further contracts to the extent of £100,000 were in negotiation when the Armistice was declared.

IN order to provide practical experience and knowledge for the engineering students of the Liverpool University, the managers of the White Star Line, after consultation with the chairman of the company (Mr. Harold A. Sanderson), have decided to grant facilities to students of the University, through the Liverpool Engineering Society, of obtaining experience at sea during their vacations.

SOME 290 ENGINEERS' APPRENTICES, employed by Ruston & Hornsby, Limited, Grantham, have declined to accept the reductions proposed by the management, and on July 7 they abstained from work. The employers had given notice of the following reductions:—Boys under 17, 1s. per week now, another 1s. per week in a month, and 2s. 6d. per week in September; over 18, 2s. 6d. now, 2s. 6d. in a month, and 5s. in September.

THE 5-UNIT KLING-WEIDLEIN CLEANER, ordered some time ago by the Shelton Iron, Steel & Coal Company, Limited, is now completely erected, and will be put into operation as soon as the company's furnaces are again in blast. The results to be obtained by this equipment, which has excited a great deal of comment amongst blast-furnace owners, will be awaited with interest, and it is fully expected that these results will be equal to those obtained in several American installations.



MISCELLANEOUS advts., see also page 14.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited. Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with VIDEX PATTERN WORKS AND FOUNDRY, Huntsworth Mews, Upper Baker Street, London, N.W.1. (Telephone, Paddington 364).

FOR SALE, cheap, 100 tons of Foundry Pig-iron, planished, and C.R. C.A. Sheets, Joists, Channels, Angles, Tees, Plates, all thicknesses, Plumbago.—ASCOG, 10, Goldsmith Place, Kilburn, N.W.6. Telephone: Hampstead 8532.

WE Specialise in FANS and FAN WORK for Foundries. H.P. Fans and Blowers for Smiths' Hearths, Cupolas, Oil and Gas-fired Furnaces, Dust Extraction Fans for Fettling Shop and Sand Blast, Ventilating Fans for Fumes, etc. Worm-geared Pulley Blocks, 10 cwt. to 10 tons.—PROGRESSIVE ENGINEERING COMPANY, LIMITED, Leicester.

ADOLPH KNUTTEL,

STATION GRAVEL PITS,
FLITWICK, AMPTHILL.

SAND, BALLAST OF EVERY DESCRIPTION.

QUOTATIONS GIVEN D/D or F.O.R

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	70	2	6
Three months	70	10	0
Electrolytic	74	10	0
Tough	70	15	0
Best selected	71	5	0
Sheets	107	0	0
India	107	0	0
Wire bars	75	0	0
Do. Sept.	75	0	0
Do. Oct.	75	0	0
Ingot bars	75	0	0
H.C. wire rods	82	0	0
Off. aver. cash, June 71	18	2	19/32
Do. 3 mths., June 72	3	3	9/16
Do. Settlement Jun 71	17	6	
Do. Electro, June 76	11	4	5/16
Do. B.S., June	72	17	6
Aver. spot, copper, June	71	17	3½
Do. Electro, June	77	9	1

Solid drawn tubes 15½d.
Brazed tubes 15½d.
Wire 11½d.
Yellow metal rods 8d
Do. 4x4 Squares 9⅛d.
Do. 4x3 Sheets 9½d

BRASS.

Solid drawn tubes 13½d.
Brazed tubes 16½d
Rods 11⅛d.
Sheets to 10 w.g. 11½d.
Wire 11⅛d.
Rolled metal 10½d.

TIN.

	£	s.	d.
Standard cash	161	10	0
Three Months	164	0	0
English	161	0	0
Bars	165	10	0
Chinese	159	0	0
Straits	165	0	0
Australian	165	0	0
Eastern	170	0	0
Banca	167	0	0
Off. aver., cash, Jun 167	2	10	3/16
Do. 3 mths., Jun 169	13	1	½
Do. Sttlment., Jun 167	11	7	5/16
Aver. spot, June	167	10	5½

SPELTER.

	£	s.	d.
Ordinary	26	10	0
Remelted	22	10	0
Hard	16	10	0
Electro 99.9	35	0	0
English	33	0	0
India	20	15	0
Prime Western	27	7	6
Zinc dust	45	0	0
Zinc ashes	6	0	0
Off. aver., June	27	2	21/32
Aver., spot, June	26	15	0

LEAD.

	£	s.	d.
Soft foreign ppt	23	10	0
English	24	15	0
Off. average, June 22	9	11	7/32
Average spot, June 23	11	4	½

ZINC SHEETS.

	£	s.	d.
Zinc sheets, spot	35	0	0
Do. V.M. ex. whf	36	0	0
Do. ppt., f.o.b., N.Y.			—
Dutch	35	10	0
Boiler plates	33	0	0
Battery plates	32	10	0

ANTIMONY.

	£	s.	d.
English regulus	37	0	0
Special brands	42	0	0
Chinese	25	0	0
Crude	18	0	0

QUICKSILVER.

Quicksilver 11 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% £15 0 0
75% £22 0 0

Ferro-vanadium—
35/40% 22/- lb. va.

Ferro-molybdenum—
70/80% 10/- lb. mo.

Ferro-titanium—
23/25%, carbonless 1/6 lb.

Ferro-phosphorus, 20/23% £28

Ferro-tungsten—
80/85%, carbon free 1/7 lb.

Tungsten metal powder—
98/99% 2/- lb.

Ferro-chrome—
4/6% car. £36
6/8% car. £35 10
8/10% car. £35

Ferro-chrome—
Max. 2% car. £82
Max. 1% car. £98
Max. 0.75% car. £112
65/75%, carbonless 2/8 lb.

Nickel—99·8%, cubes or pellets £190

Cobalt metal—97% 7/- lb.

Aluminium—98/99% £150

Metallic Chromium—
98/99% 5/9 lb.

Ferro-manganese—
76/80%, loose £18
76/80%, packed £19
76/80%, export £14

Metallic manganese—
98/99%, carbonless 2/9½ lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9
Scrap pieces		5d.
Turnings and swarf		3d.

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing 4s. cwt
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 5d.
Turnings and swarf 3d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£ s. d.	£	s.	d.
Heavy Steel	3	10	0
Bundled steel & shearings	2	15	0
Mixed iron & steel 1 0 0	4	0	0
Heavy cast iron	3	10	0
Good machinery for foundries	6	0	0
Cleveland—			
Heavy steel	3	2	6
Steel turnings	2	5	0
Cast-iron borings	2	5	0
Heavy wrought iron piling	3	5	0
Bundling scrap	4	0	0
Cast-iron scrap	5	10	0
Lancashire—			
Cast iron scrap	6	10	0
Heavy wrought	3	0	0
Steel turnings	1	10	0
London—			
Copper (clean)	53	0	0
Brass (clean)	30	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	12	0	0
New aluminium cuttings	60	0	0
Braziery copper	43	0	0
Gun metal	45	0	0
Hollow pewter	135	0	0
Shaped black pewter	80	0	0

PIG-IRON.

(Premiums required for foundry).

N. E. Coast—	
Foundry No. 1	125/-
Foundry No. 3	120/-
Forge No. 4	117/6
Mottled	117/6
Hematite No. 1	162/6
Hematite M/Nos.	160/-
Midlands—	
Staffs. common	145/-
„ part-mine forge	160/-
„ „ foundry	170/-
„ Cold blast	—
„ basic	140/-
Northants forge	140/-
„ foundry No. 3	147/6
„ basic	140/-
Derbyshire forge	150/-
„ foundry No. 3	160/-
„ basic	150/-
Scotland—	
Foundry No. 1	177/6
„ No. 3	172/6
Hematite M/Nos.	180/-
Sheffield (d/d district)—	
Derby forge	155/-
„ foundry No. 3	160/-
„ basic	155/-
Lincs. forge	160/-
„ foundry No. 3	170/-
„ basic	162/6
E.C. hematite	173/-
W.C. hematite	176/-

All d/d in the district.

Lancashire (d/d eq. Man.)—	
Derby forge	—
„ foundry No. 3	170/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	172/6
„ foundry No. 3	177/6
Summerlee foundry	195/6
Glengarnock foundry	198/-
Gartsherrie foundry	195/6
Monkland foundry	195/6

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (crown)	16	0	0
Angles	16	10	0
Tees to 3 united ins.	17	0	0
Nut and bolt	16	0	0
Hoops	20	5	0
Marked bars (Staffs.)	20	0	0
Gas strip	20	0	0
Bolts and nuts, ⅝ in. × 4 in.	35	0	0
Steel—			
Ship plates	15	0	0
Boiler plates	21	0	0
Chequer plates	15	10	0
Angles	14	10	0
Tees	15	10	0
Channels	14	15	0
Joists	14	10	0
Rounds, ⅜ in.–3-in.	14	0	0
Rounds, 3 in.–5½ in.	13	10	0
Flats, 5 in.–8 in.	15	0	0
Flats over 8 in.	15	0	0
Rails, heavy	14	0	0
Fishplates	19	0	0
Hoops	16	10	0
Black sheets, 24 g.	19	0	0
Galv. cor. sheets, 24 g.	24	0	0
Galv. fencing wire, 8 g. plain	19	10	0
Rivets, ¾ in. dia	26	0	0
Billets, soft	10	10	0
Billets, hard	11	10	0
Sheet and tin bars	10	10	0

PHOSPHOR BRONZE.

	Per lb basis.
Strip	1 6½
Sheet	1 7½
Wire	1 6¾
Rods	1 6¼
Tubes	1 8¾
Castings	1 4

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/- to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks	1/1 to 1/7
Ingots rolled to spoon size	1/4 to 1/10
Wire round—	
3/0 to 10. G.	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	25.50
No. 2 foundry Valley	21.00
No. 2 foundry, Birm.	20.00
Basic	21.96
Bessemer	23.46
Malleable	24.46
Grey forge	21.96
Ferro-manganese 80 % delivered	75.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	35.00
Wire rods	48.00
	Cents.
Iron bars, Phila.	2.25
Steel bars	1.90
Tank plates	2.00
Beams, etc.	2.20
Skelp, grooved steel	2.10
Skelp, sheared steel	2.10
Steel hoops	2.75
Sheets, black, No. 28	3.50
Sheets, galv., No. 28	4.50
Sheets, blue an'l'd, 9&10	2.65
Wire nails	3.00
Plain wire	2.75
Barbed wire, galv.	3.65
Tinplate, 100-lb. box	$5.75

COKE.

Welsh foundry	67/6
„ furnace	55/-
Durham & North. foundry	70/-
„ furnace	42/6
Other Districts, foundry	77/9
„ furnace	45/-